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ABSTRACT

This classroom guide for metric education included a brief rationale and history of metrics, a preliminary metric quiz, a symbol summary, and a list of recommended instructional materials. The guide is comprised primarily of four sections covering the topics of: weight, length, volume, and temperature. Each of these sections contains goals and activities for early childhood and for upper grade students as well as activity worksheets. A section describing metric games for reinforcing symbols is also included. (MN)

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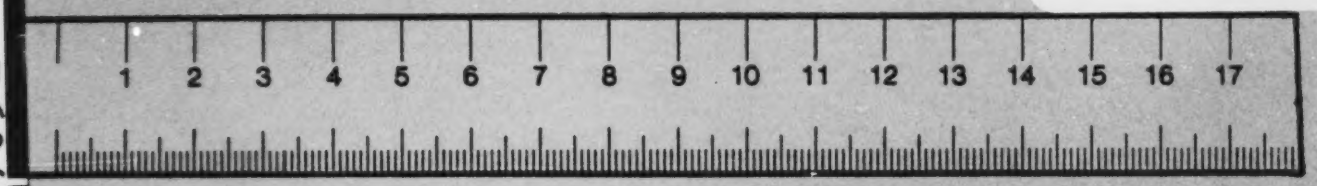
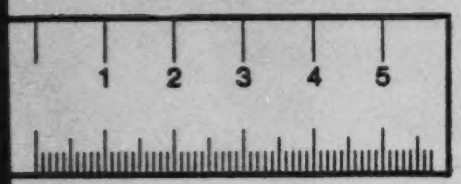
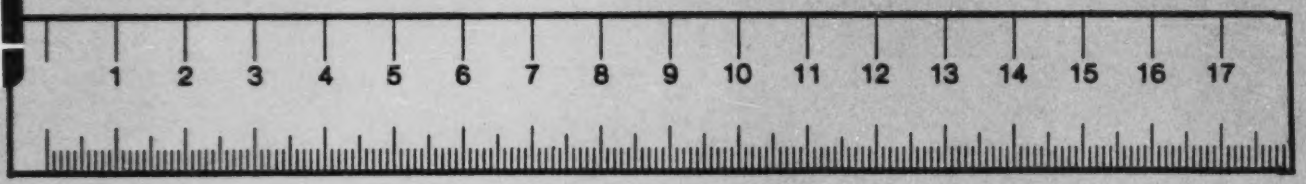
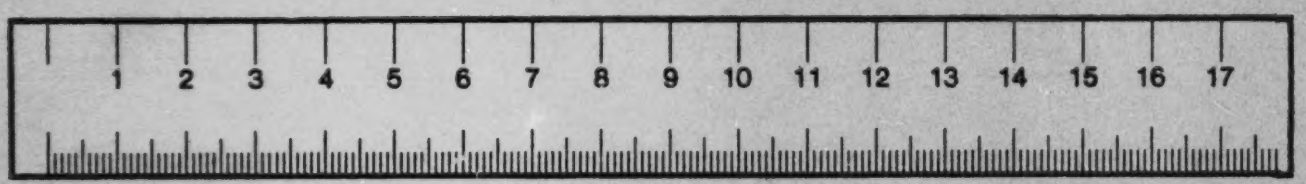


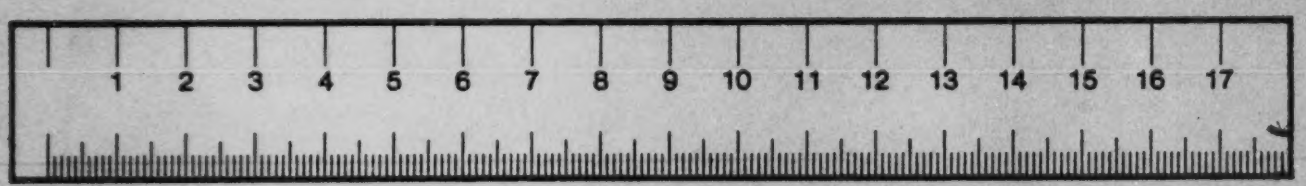


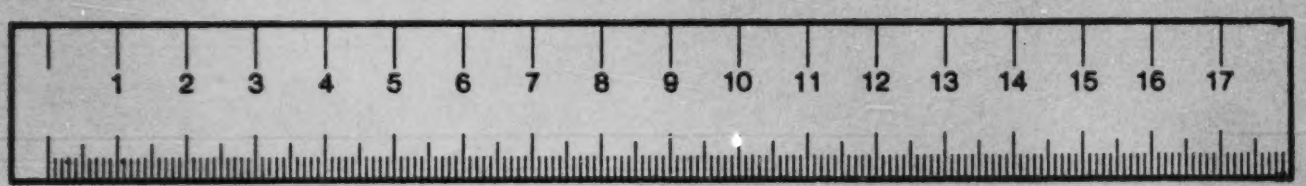
METRICS MADE EASY

A Classroom Guide • 1978









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MEASURING - WHY IS THERE A STANDARD?

Eric measures the door as 4 books wide, and Mark measures the same door as 5 books wide, but each has used different books. Soon they will understand the need for a standard unit of measurement. Perhaps they will agree to choose the length of Eric's foot as the unit and then it will be easier to discuss this measurement. In using a "foot", the children will see that parts of what they measure will be left over. Perhaps it would be appropriate then to choose a smaller unit.

Choosing arbitrary units of measure shows the children that they may use anything as a measuring unit, but it would be difficult to talk about measures if we all adopted a different standard.

Children should get a feeling for when a unit is appropriate. Measuring the room with giant steps is more economical than with fingers! Allowing everyone to choose his or her own unit will show the children how impractical this system is.

Activities To Illustrate Need For Measurement

I. To compare items in terms of different attributes (classifications):

   a) Divide the class into groups and have eachgroup arrange itself in a line according to height.

   b) Prepare small, identical-appearing mystery boxes of varying weights and have children lift them, separating them first into "heavy" and "light", and then putting them in order by weight.

II. To compare area differences:

   a) Remove screw tops from a number of bottles and jars; scramble the tops; line up the jars and bottles and see if children can choose by looking which is the correct top for each container. Check by putting the tops back on.

   b) Have children do some checking and testing of volume by filling a number of glass containers with marbles. Have the children arrange them by content according to the number of marbles each container holds.

III. To measure lengths, distances, etc.:

   a) Select brightly-colored red, yellow, green and blue ribbons. Cut them into varying lengths. Mix the colors and permit students to determine measurements by means of "3 reds, 2 yellows,

a blue and 4 greens." Class can measure each other's height, width of desks, depth of windowsills, blackboard dimensions, etc.

b) Choose non-standard objects to facilitate measurement. (i.e. books, pencils, lunch boxes, shoes.) With young children, the first experience of measuring can be with the body or some part of it as the measuring unit. Have the children measure a single object with different-sized units of measure. Encourage them to talk about their work. "When I measured the table, it was 10 hands wide," a student might say. And another might report: "When I measured the table with my fingers, it was 50 fingers wide."

Which unit used was shorter? Which unit used gives the greatest number when you measure the table? Through many experiences, the children should come to see that the shorter the unit used for measuring, the greater the number of units required to find a result.

IV. To measure units of volume:

a) Objects such as buttons, beans, marbles or blocks can be used to fill different-sized containers. How many blocks will it take to fill this shoebox? How many to fill this bowl?

b) Experiment with weighing on a balance scale. For example, if an orange is going to be a standard unit of weight, we can try to find out how many cookies or pencils or beans it takes to balance the orange.

And now on to METRICS...

A BRIEF HISTORY OF THE METRIC SYSTEM

In 1791, the French Academy of Sciences presented a new system of measurement, the metric system. By the 1850's, people in many parts of the world accepted this system.

Officially, the System International, or "SI", is a measurement system in which the basic unit is a meter -- one ten-millionth of the distance from the Equator to the North or South Pole.

The units for larger or smaller measurements are all multiples of ten of the standard unit. The word, meter, comes from the Greek word, meaning "to measure." The larger or smaller units add a Latin or Greek prefix to the basic unit. Thus, kilometer (kilo means "thousand") is the unit for longer distances, and the centimeter (centi means on one-hundredth) is the unit for shorter lengths.

The gram is the unit for weight, and the kilogram measures really heavy weights. To measure volume, (i.e. milk, gasoline, or grapes), the liter is used.

However, the entire system is based upon the meter -- a square meter for area, a cubic centimeter for mass, a cubic decimeter for volume. It is very simple to change one unit to another because the next higher unit always is 10 times greater than the previous one. Thus, 10 millimeters equal 1 centimeter, 10 centimeters equal 1 decimeter, and 10 decimeters equal 1 meter.

To translate millimeters to centimeters, all you do is divide by 10. That means you just move the decimal point one place to the left. 436 millimeters become 43.6 centimeters; and 43.6 centimeters become 4.36 decimeters. When you want to change larger units to smaller units, you multiply by ten. Therefore, 43 kilograms become 430 hectograms and 4,300 decagrams.

HELPFUL HINTS

A meter is a little longer than a yard.

A liter is a little larger than a quart.

A kilogram is a little more than two pounds.

A kilometer is about 0.6 of a mile.

Water freezes at 0^{o} Celsius and boils at 100^{o} Celsius.

WHAT'S YOUR METRIC IQ?

Write "U" if any of the statements below is unlikely.
Write "L" if the statement is likely.

_____1) The basketball player is 3 meters tall.

_____ 2) The bicycle was traveling 20 kilometers per hour.

_____ 3) He drank a liter of pop in one gulp.

_____ 4) The temperature dropped to 25 degrees Celsius and it started to snow.

_____ 5) The football player weighed 120 kilograms.

_____ 6) The pencil weighed 100 grams.

_____ 7) His foot is 5 decimeters long.

_____ 8) The area of a postage stamp is 20 square centimeters.

_____ 9) He purchased 250 millileters of pop for 15 cents.

_____10) The beauty contestant measured 90-60-90 centimeters.

The answers: 1-U; 2-L; 3-U; 4-U; 5-L; 6-U; 7-U; 8-U; 9-L; 10-L.

10

SUMMARY OF THE METRIC SYSTEM

There are three basic units:

1. METER
2. LITER
3. GRAM

Common Units of Measurement

Measurement	Name of Unit	Symbol
length	meter	m
mass	gram kilogram	g
capacity	liter	ℓ
time	second	s
temperature	degree Celsius	C

How to Change the Basic Units

The metric system of measurement, like our number system and our decimal coinage system, is based on multiples of ten. Each of the basic units may be changed into a larger or a smaller unit by means of the following prefixes:

Prefix	Symbol	Means multiply the base unit by:
kilo	k	1000 (1 g x 1000 = kg)
hecto	h	100
deka	da	10

BASIC UNITS - METER (m), LITER (ℓ), GRAM (g)

↑ LARGER

↓ SMALLER

deci	d	0.1 or 1/10 (1 g x 0.1 = dg)
centi	c	0.01 or 1/100
milli	m	0.001 or 1/1000

INSTRUCTIONAL RESOURCES

The following instructional materials are recommended for purchase as a minimal requirement for a teacher to implement instruction of the metric system:

Length & Area

*centimeter (cm) rulers with millimeter (mm) calibrations

*meter (m) sticks

*2.5 meter wall strips for making your own metric rulers

*master copies of centimeter graph paper

*transparencies of centimeter graph paper

*a meter trundle wheel

*classroom sets of Cuisenaire rods

Volume/Capacity

*centimeter cubes

*a set of graduated beakers

*a set of graduated cylinders

*a set of multi-shaped liter containers

*a bucket

Weight

*(brass and plastic) gram (gm) mass weights

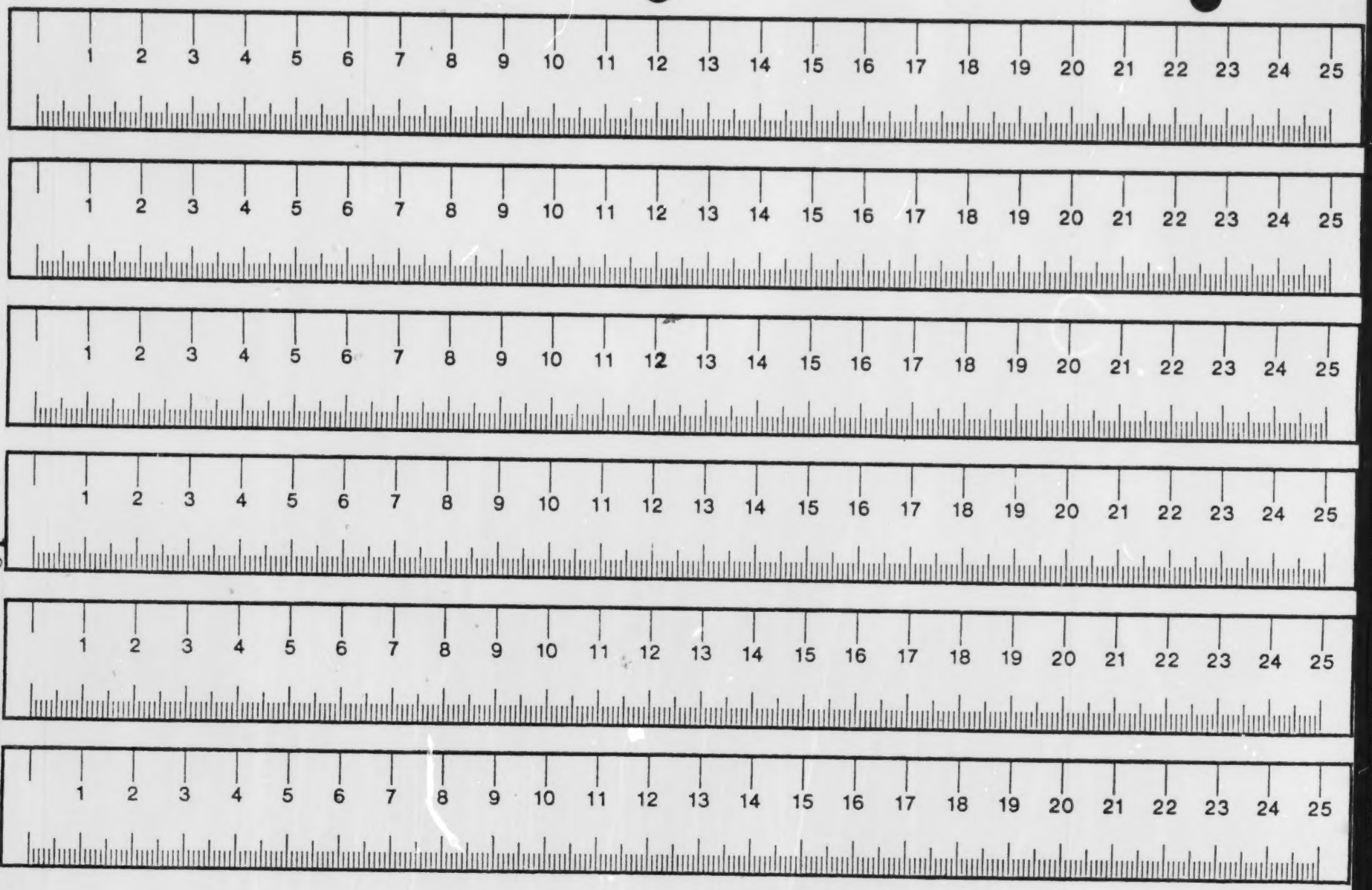
*equal arm balance scale (see illustration on how to make your own)

*spring scale

Temperature

*indoor-outdoor Celsius thermometer for classroom

CENTIMETER RULERS



WEIGHT

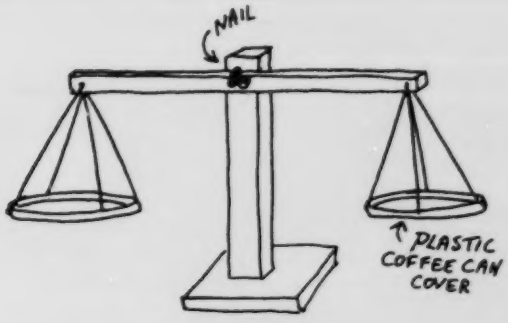
Dry Weight Measurements:

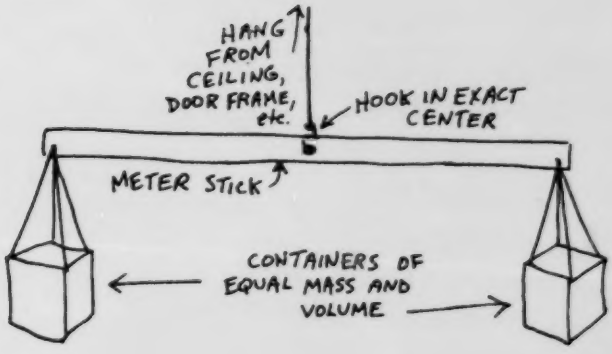
1000 milligrams (mg)	equals	1 gram (g)
1000 grams (g)	equals	1 kilogram (kg)
1000 kilograms (kg)	equals	1 tonne (t)

Guides for Weight Measures

Nickel	equals	5 grams
Dime	equals	2 grams
Penny	equals	3 grams
Quarter	equals	5.5 grams
Regular paper clip	equals	0.5 grams
Thumb Tack	equals	0.5 grams
Unused stick of chalk	equals	12 grams
Blackboard eraser	equals	30 grams
Medium-sized apple	equals	130 grams
New pencil with eraser	equals	4.5 grams
A slice of bread	equals	22 grams

Making a Balance - Two Different Ways





WEIGHT
EARLY CHILDHOOD

I. Goal: To teach concepts of gram and kilogram

II. Activities to Achieve Goal

1. Compare objects of various weights such as boxes of tissues, empty sealed boxes (some filled with sand, paper, cotton). Children will find that weight does not necessarily depend on size. Have children hold each box and match to corresponding "weight" words: heavy, heavier, heaviest, lightest, etc.

2. Have children bring in food packages and can labels from home that have their weights marked in grams and ounces. Have children make a display of their findings.

3. What is a gram?

To familiarize students with the meaning of a gram, use balance scale, some nickels and paper clips. Label the nickel 5 grams (use masking tape). Develop a chart like this one through trial and error with your group:

1 Nickel (5 grams) balances with _____ paper clips.
1 Nickel (5 grams) balances with _____ thumb tacks.
1 Nickel (5 grams) balances with _____ buttons.

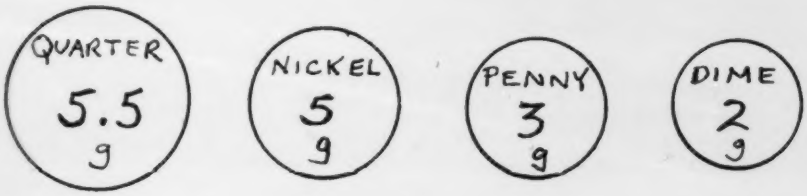
Let the children add to the list.

4. What is an ounce? Is it bigger than a gram?

Develop a series of common objects as "standards of weight" to use with the balance scale. Use pennies, nickels, dimes, quarters, etc. and a postal scale (or diet scale).

Let the children find out how much each coin weighs on the postal scale.

Since 1 ounce equals 28 grams, you can multiply the number of ounces by 28 to see how many grams it weighs. After determining weight in grams, label the coin with masking tape. You will then have a set of standards for classroom use.



Play a guessing game with weights letting children guess how many grams something weighs (use the labelled coins as a reference point).

5. Have children find other classroom materials that weigh 5 grams; 15 grams; 25 grams; 100 grams. Make a visual chart for reference within the classroom. Verify by weighing.

In setting up a reference set of weights, common objects are good to use. Students will start to think grams and kilograms easily when they can relate the weights to everyday objects they see and handle.

6. What is a kilogram?

   To help students get the feel of a kilogram weight use a balance scale and 200 nickels for weight as a "standard" for kilogram.

   Many of the foods we buy are measured in pounds, the basic unit for weight in the English system. In the metric system, the kilogram is the basic unit. Its weight is equal to 200 nickels. Each nickel weighs 5 grams. It takes 200 to equal 1,000 grams or one kilogram. Take 200 nickels and put them in a bag.*

7. Have children construct simple mobiles to provide a visual display of common objects with weights given in grams and kilograms.

   One mobile may contain only items or pictures of items that weigh in at "1 kilogram"; another could be the "10 gram" mobile.

8. Prepare metric snacks to give experience in using differing metric measures.

9. Have children bring in favorite recipes which they can convert to Metric Recipes by using the classroom scales and standards of weight. (See weight activity sheets A-B)

*If it is difficult to use 200 nickels use a clay ball. Wrap the clay ball in aluminum foil so the clay does not rub off.

UPPER GRADES

I. Goals: To extend understanding of gram and kilogram, to develop concept of mass weight (metric tonne)

II. Activities to achieve goals:

1. How much do you weigh?

   A pound equals .45 kilograms. Knowing this, have children figure out how many kilograms they weigh. Graph the results for a class weight chart in kilograms.

2. Have class ask their family to estimate their weight in kilograms. Question should be "How many kilograms do you think you weigh?

   40 kg 80 kg 100 kg 20kg

   Graph their estimated weight against their actual weight in kgs.

3. Choose ten people. Find out their weight in kilograms. (Convert when necessary). Make a graph of the results.

4. As a class project have children change English weighing scales into metric scales. Write the kilogram equivalent weight on a piece of tape which is placed on the scale.

5. How much is a ton? (A metric ton is equal to 1,000 kg). Ton is often spelled tonne in metrics.

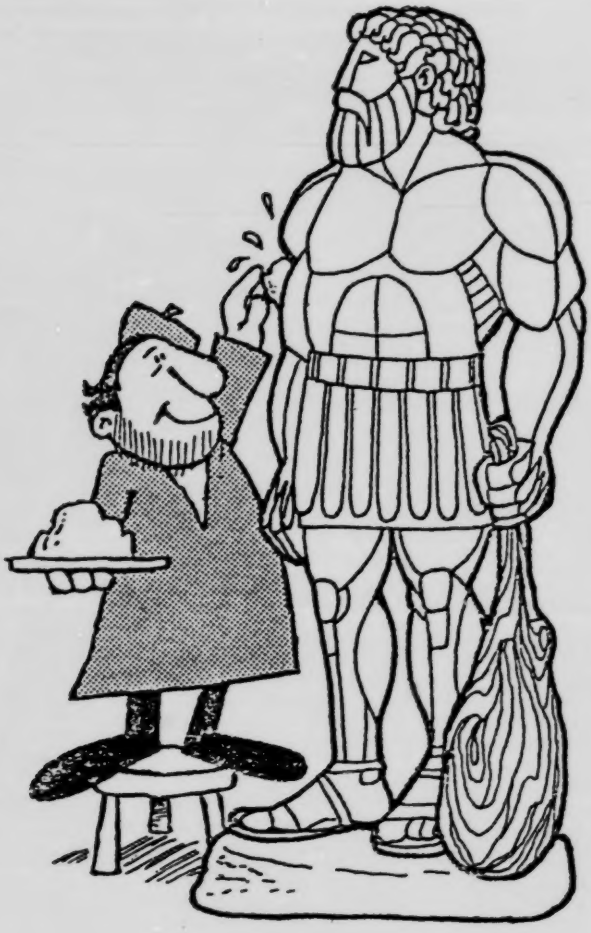
   Have a weigh-in to see how many in the class it would take to equal a metric ton. Each child must know his weight in kilograms. Keep adding children (and their kilogram weight) until you reach 1,000 kilograms.

   After the students have decided how many and which ones together equal a ton, they can expand the concept to include pictures of objects that together weigh a metric ton.

6. Simple weight activity sheets C-G reinforce above activities 1-5*.

   More difficult activity sheets H-K also reinforce above activities 1-5.

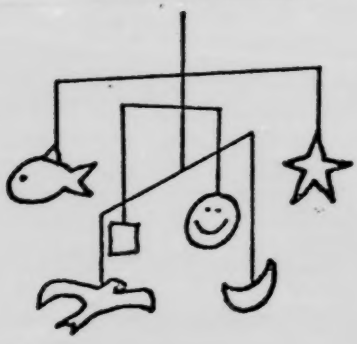
Metric Modeling Dough



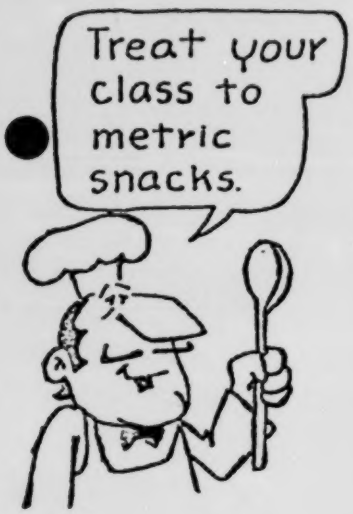
250 mℓ salt
250 mℓ flour
125 mℓ water (or enough to make stiff dough)
food coloring

Mix the flour and salt together. Stir in the water and food coloring. Knead the dough for about 5 minutes. Store in a plastic bag.

Roll some dough very thin and cut shapes for a mobile.
Let it harden. Decorate with paint.



Make tiny beads for a necklace. Use your imagination!



SESAME CRISP CRACKERS *

375 mℓ whole wheat flour
60 mℓ soy flour
60 mℓ sesame seeds
4 mℓ salt
60 mℓ oil
125 mℓ water (as needed)

Stir flours, seeds, and salt together; pour in oil and blend well. Add enough water to the dough to make it of pie dough consistency. Gather the dough into a ball, then roll it to 3mm thick. Cut it in cracker shapes or sticks and place on ungreased baking sheet. Bake at 175°C (or 350° F) until crackers are crisp and golden.

PARTY SNACK *

190 mℓ roasted peanuts
250 mℓ roasted sunflower seeds
250 mℓ roasted cashews
250 mℓ raisins
250 mℓ toasted, shredded coconut
salt (optional)

Combine all ingredients and serve.

CHEESY REFRITO DIP

250 mℓ refried beans
20 mℓ chopped green chilies
100 mℓ grated cheese
pinch of salt

Mix together and heat until the cheese begins to melt. Serve with corn chips.

PEANUT BUTTER LOG *

125 mℓ peanut butter
40 mℓ nonfat dry milk-more as needed
125 mℓ raisins
30 mℓ honey (optional)

Blend peanut butter (and honey), then work in as much powdered milk as you need to make the mixture easy to handle and fairly stiff. Pick up the mixture and knead in the raisins, distributing them evenly. Roll into a 3 cm thick and 25 cm long log. Chill and slice or pull apart. The mixture can be molded into any shape or pressed into cookie molds.

Use a kilogram mass and a balance scale to find some things which balance 1 kg.

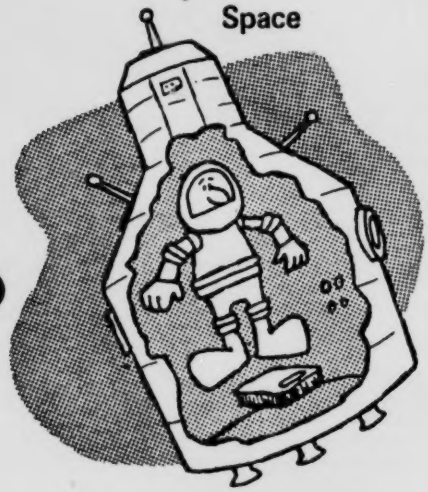
Mass and Weight

Earth

mass: 78 kg

scale reads: 78 kg

Space



mass: 78 kg

scale reads: 0 kg

Moon

mass: 78 kg

scale reads: 13 kg

You are an astronaut. Weigh yourself in kilograms and complete the information as in the cartoons.

EARTH

mass _____

scale reads _____

SPACE

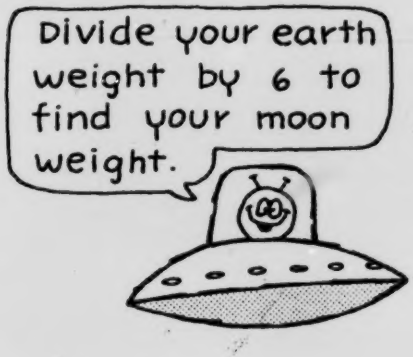
mass _____

scale reads _____

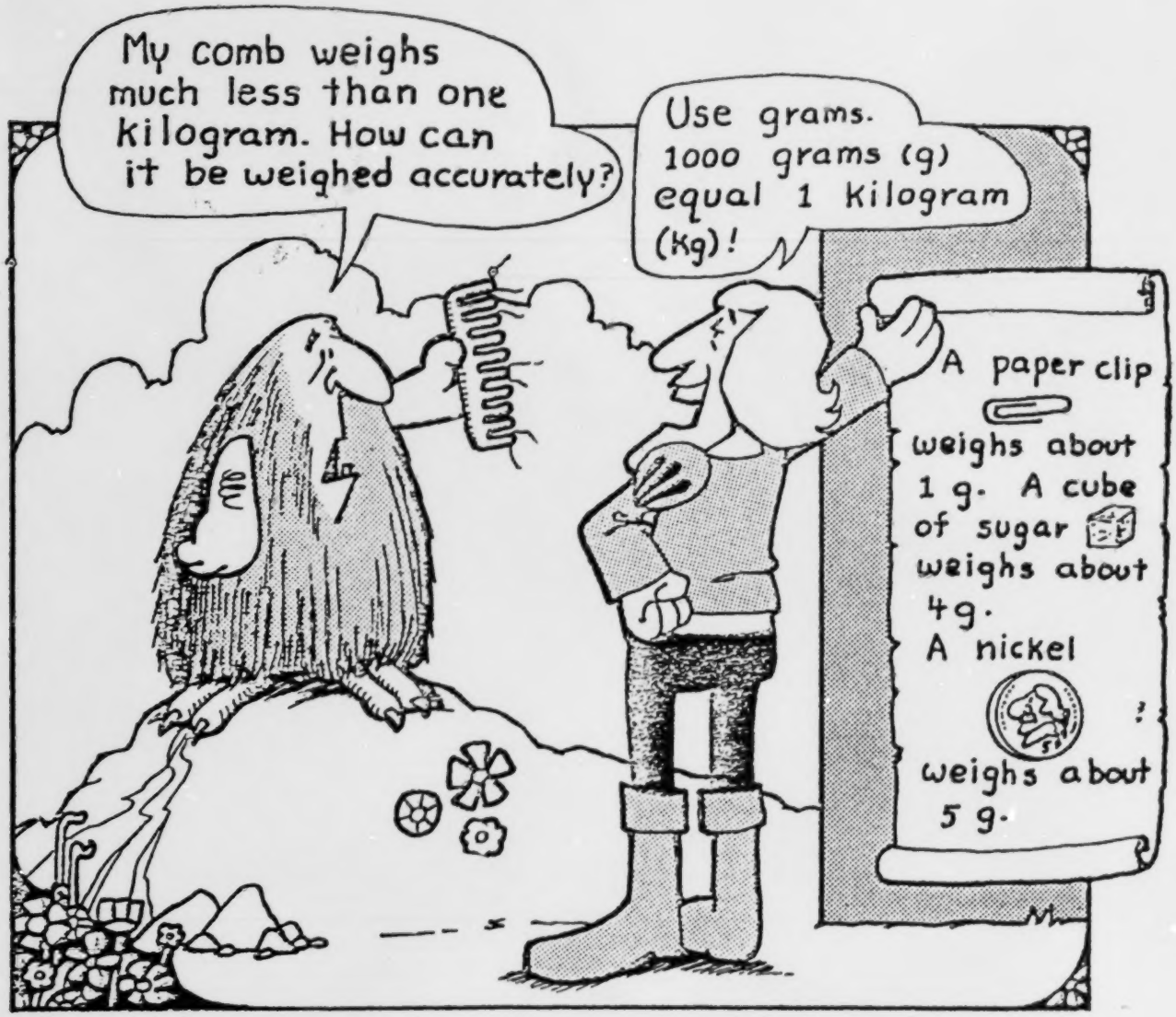
MOON

mass _____

scale reads _____



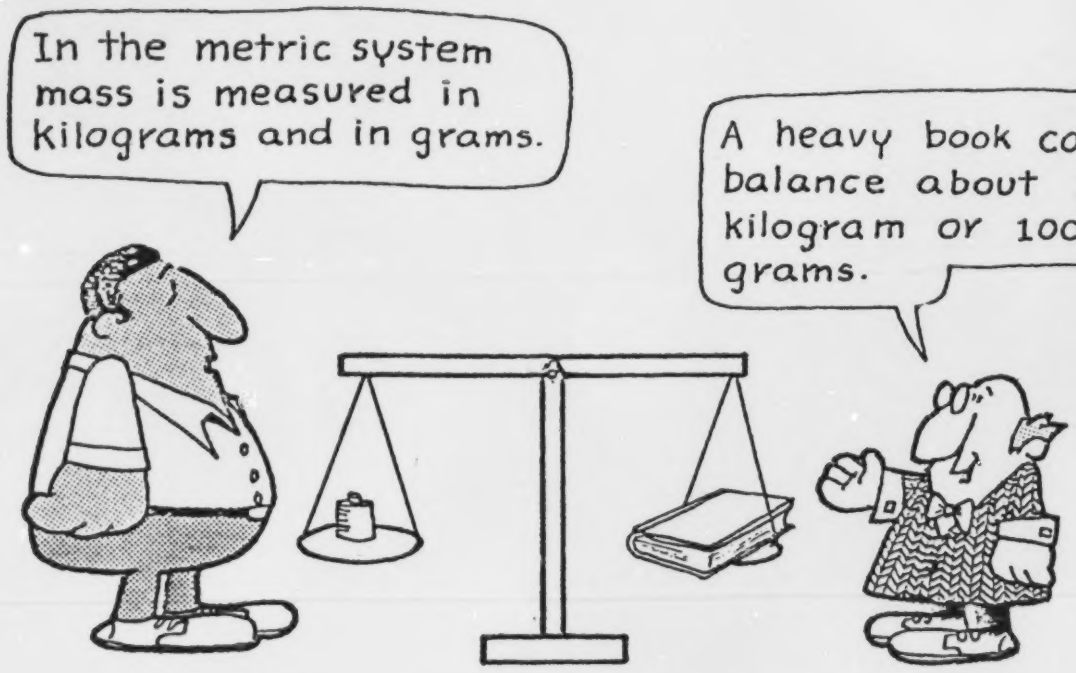
Weight and mass describe different things but on earth we commonly use both terms in the same way. In this book we will use the more familiar term of weight.


My comb weighs much less than one kilogram. How can it be weighed accurately?
Use grams. 1000 grams (g) equal 1 kilogram (kg)!
A paper clip weighs about 1 g. A cube of sugar weighs about 4 g.
A nickel weighs about 5 g.

Use metric weights to find things that weigh about:

1 g	5 g	50 g	1000 g or 1 kg

Which would you rather have, a kilogram of quarters, or a kilogram of dimes? Use a balance scale to show why.
What would you be worth if you were worth your weight in quarters?



Use a balance scale to find what metric units balance

a jar of paste _____

a bag lunch _____

a shoe _____

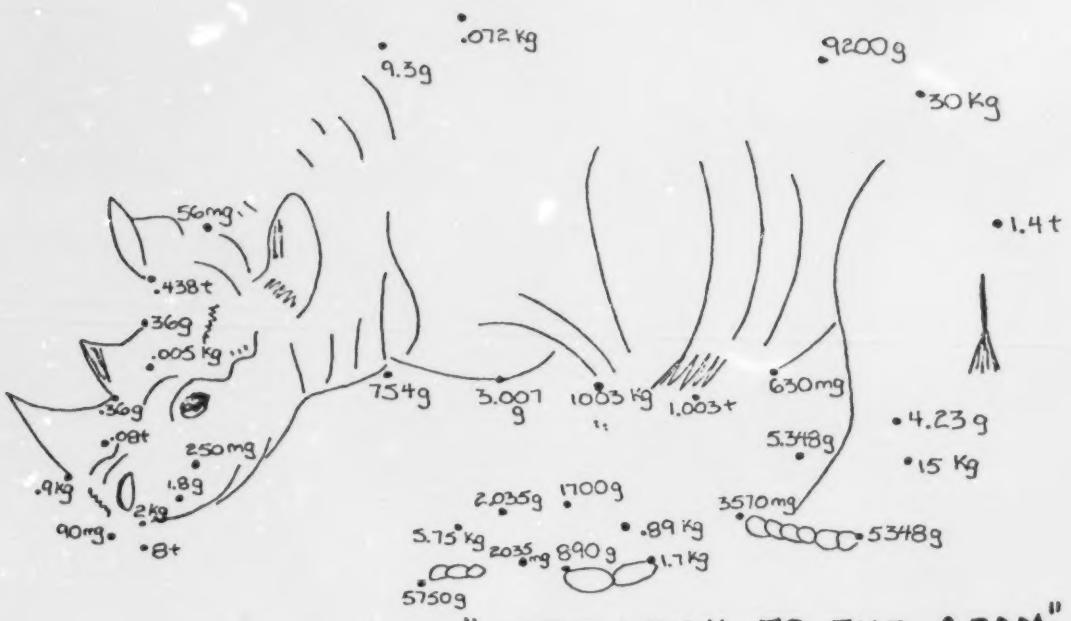
a ream of paper _____

a pencil _____

_____ _____

_____ _____

MASS

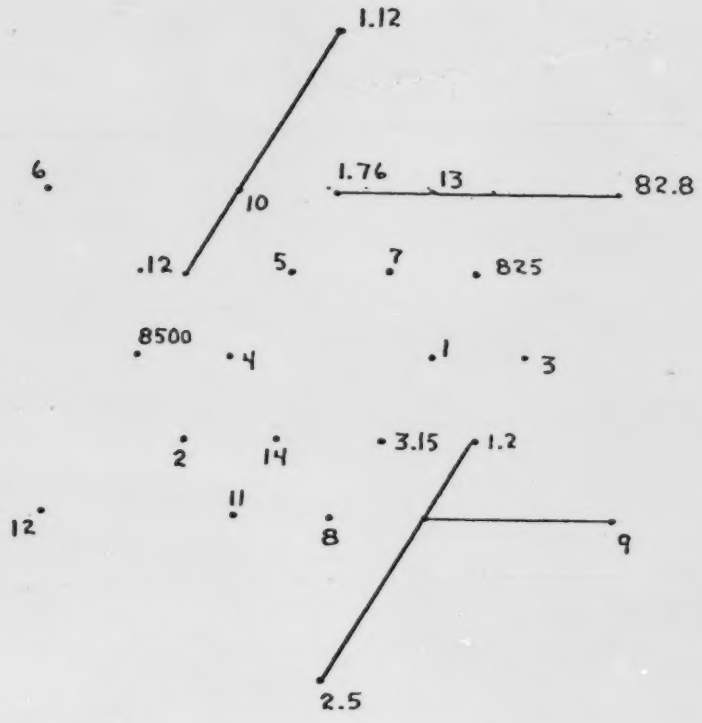


"MORE WHAM TO THE GRAM"

Connect the answers in order.

1. .25 g = _____mg
2. 1800 mg = _____g
3. 2000 g = _____kg
4. 8000 kg = _____t
5. .09 g = _____mg
6. 900 g = _____kg
7. 80000 g = _____t
8. 360 mg = _____g
9. 5000 mg = _____kg
10. .036 kg = _____g
11. 438 kg = _____t
12. .056 g = _____mg
13. 9300 mg = _____g
14. 72 g = _____kg
15. 9.2 kg = _____g
16. .03 t = _____kg
17. 1400 kg = _____t
18. 4230 mg = _____g
19. 15,000 g = _____kg
20. 5 kg 348 g = _____g
21. 3 g 570 mg = _____mg
22. 5 g 348 mg = _____g
23. .6 g 30 mg = _____mg
24. 1 t 3 kg = _____t
25. 1 t 3 kg = _____kg
26. .8 kg 90 g = _____kg
27. .8 kg 900 g = _____kg
28. .8 kg 90 g = _____g
29. .8 kg 900 g = _____g
30. 3 g 7 mg = _____g
31. 2 g 35 mg = _____g
32. 2 g 35 mg = _____mg
33. 5 kg 750 g = _____g
34. 5 kg 750 g = _____kg
35. .67 kg 84 g = _____g

MASS



Connect the number of each problem with the answer for that problem.

1. How many kilograms in 8000 grams? _____kg
2. If one kilogram of blueberries costs 45 cents, what is the cost of 7 kilograms? $_____
3. Four heavyweight boxers weighed 82 kg, 81.3 kg, 84.4 kg, and 83.5 kg. What was their average weight? _____kg
4. A certain cut of beef costs $4.40 per kilogram. What is the cost of 400 grams of this meat? $_____
5. The average weight for eleven members of a certain high school football team is 75 kilograms per player. What is the total weight of the team? _____kg

6. If a rare spice costs $20.00 per kilogram, what is the cost per gram? _____¢/g

7. The weight of the discus for the Olympic discus throw is 2 kg. The javelin for the javelin throw weighs 800 grams. What is the difference in their weights? _____kg

8. When Laura was in the sixth grade she weighed 31 kg. In the eighth grade she weighed 43 kg. How much weight did she gain in those two years? _____kg

9. How many milligrams in .825 grams? _____mg

10. On a shopping trip Leone bought a kilogram of coffee for $1.98 and her sister, Hope bought 500 grams of coffee for $1.02. How much cheaper per kilogram was Leone's coffee? _____¢

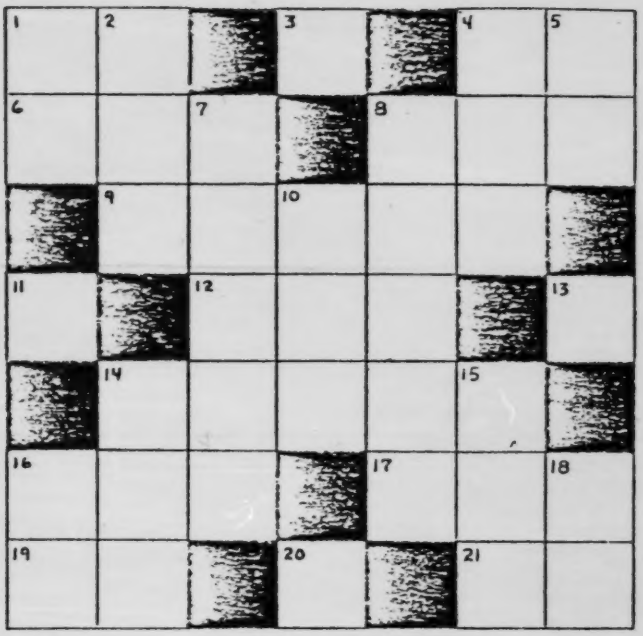
11. Diana's poodle Pierre weighs 5 kg. If he has doubled his weight in the past two years, how much did Pierre weigh two years ago? _____kg

12. If each of 68 boxes of food weighed 125 kg, how much did the boxes weigh altogether? _____kg

13. If a 500 grams can of peas cost 28 cents, what is the cost for 4 cans of peas? $_____

14. If crackers cost 60 cents for 500 grams, how much (to the hundredth of a cent) is a gram of crackers? _____¢

MASS



Across

1. The heaviest domestic cat, Gigi, weighed about 19 kg. What is the weight of a cat 8 kg lighter? _____kg
3. A cubic centimeter of water weighs 1 gram. What is the weight of 7 cm^3 of water? _____g
4. .017 kg = _____g
6. A poodle weighed 3.514 kg before cutting and 3.387 kg after cutting. How many grams of hair were cut off? _____g
8. An office typewriter weighs about 18 kg. How much do 6 such typewriters weigh? _____kg
9. A taxi weighs 1875 kg. What is the total weight of 6 taxis? _____kg
11. A milliliter of water weighs 1 gram. What is the weight of 6 ml of water? _____g
12. The greatest weight lifted by a woman is 1620 kg. What would half that weight be? _____kg
13. A thirteen year old girl, weighing 45 kg, claimed that she weighed 1/9 that amount at birth. How much did she weigh at birth? _____kg
14. A small car weighs 1295 kg. What would 9 of these cars weigh? _____kg
16. The greatest weight lifted by a man is 2850 kg. What would 1/3 of that weight be? _____kg

17. .312 t = _____kg

19. A tennis racket weighs about 810 g. What would 100 of them weigh in kilograms? _____kg

20. Twins were born weighing 2.5 kg each. What was their combined weight? _____kg

21. One of the heaviest sets of twins on record had a combined weight which was double that of the twins in problem 20. What was the combined weight of the heavy twins? _____kg

Down

1. A two year old's weight is half of his brother's 22 kg weight. How much does the two year old weigh? _____kg

2. Eleven cats weighing 11 kg each are being weighed together. What is their total weight? _____kg

3. .007 kg = _____g

4. A football player weighs .1 t. How many kilograms is that? _____kg

A girl wishes to weigh 57 kg which is 21 kg less than she now weighs. What is her present weight? _____kg

7. 71.81 t = _____kg

8. Three trucks at a weighing station are recorded as follows: 5.006 t, 5.035 t, and 5.012 t. What is their total weight in kilograms? _____kg

10. A recipe calls for 108 g of sugar. If you are doubling the recipe, how much sugar do you need? _____g

11. If a liter of water weighs 1 kg, how much will 6 liters weigh? _____kg

13. If 1000 cm^3 of water weighs 1 kg, how much will 5000 cm^3 weigh? _____kg

14. An ex-heavyweight boxer claimed that he would need to lose 49 kg in order to get down to a fighting weight of 102 kg. What does he presently weigh? _____kg

15. A bricklayer ordered .5 t of bricks, but found that the shipment weighed 11 kg too much. What did the shipment weigh? _____kg

16. .098 t = _____kg

18. A Dachshund weighs 13 kg more than a 7 kg Boston bull. What does the Dachshund weigh? _____kg

20. 5000 kg = _____t

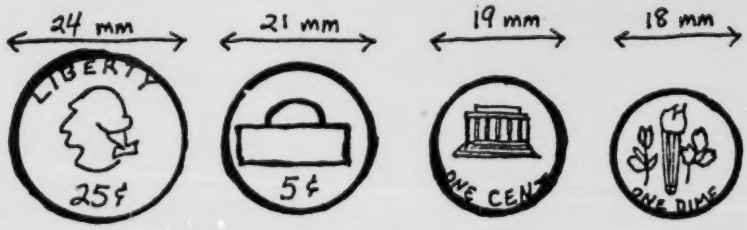
LENGTH

Measures for Length

10 millimeters	equals	1 centimeter
100 centimeters	equals	1 meter
1,000 meters	equals	1 kilometer

Guides for length measures:

Paper clip	equals	3.5 cm long; 8 mm wide
Wire of paper clip	equals	1 mm thick
Dollar bill	equals	15.6 cm long; 6.5 cm wide
New pencil	equals	19 cm long



A meter is a little more than a yard. How will you use the meter unit?

**You'll give dimensions of your living room rug in meters instead of yards.

**You'll express the distance between New York and Washington in kilometers instead of miles.

**You'll list your height in centimeters instead of inches.

**Your auto mechanic will use wrenches whose openings are designated in millimeters instead of fractions of an inch.

**You'll buy cloth by the square meter instead of the square yard.

LENGTH - EARLY CHILDHOOD

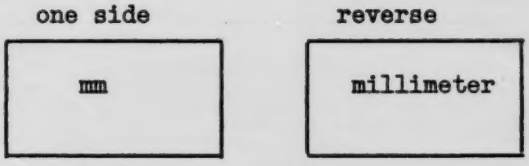
I. Goals: To teach the concept of centimeter, decimeter and meter

II. Activities to Achieve Goal:

1) Help students learn abbreviations used for metrics with this game. Make cards with abbreviations on one side and the terms they represent on the other.

Use the following abbreviations on the cards:

mm = millimeter
cm = centimeter
m - meter
dm = decimeter
km = kilometer



From a small group of children, select a leader. Leaders will rotate until each child has served as leader. The leader will hold the cards. Each member of the group will be given a turn to answer by naming the word from the appropriate abbreviation. The leader will give a point for each correct answer. When all the cards are used, the student with the most points will be the new leader. For the second round, use the word and ask for the correct abbreviation.

2) How long is a decimeter? a centimeter?

a) Make a decimeter strip (10 centimeters long); use cardboard or oak tag and scissors. See Worksheet I. (Page 22)

Use decimeter strip to measure five objects in the classroom (book, table, pencil, desk, blackboard, etc.)

b) Make a ruler from paper clips. If one paper clip equals 3.5 centimeters, make rulers of varying lengths and see which objects in the room you can find to equal those lengths.

c) Use Cuisenaire rods -- white rod = 1 centimeter
orange rod = 1 decimeter

Make trains of varying lengths using all the different colored rods. Then translate their lengths into centimeters and decimeters.

LENGTH - UPPER GRADES

I. Goals: To extend understanding of centimeter, decimeter and meter.

To introduce concept of millimeter and kilometer.

II. Activities to Achieve Goal:

1) Graphing lengths -- To permit students to visualize particular measurements, have them graph the length of their feet, waists (for children that's O.K.), a finger, a hair, etc.

2) Measuring in millimeters -- Compare thicknesses of different books in millimeters. Try to estimate the lengths of a variety of objects in mm (notebooks, pencil, eraser, bookbag, etc.)

3) The "100-meter dash"

This will acquaint students with measured distances and pacing off distances. Use a meter stick and a stop watch. Measure off a section of schoolyard.

If 100 meters is impractical because of the size of the schoolyard, adjust accordingly. Time each student as he or she runs the measured distance. See who sets the record!!

4) How many kilometers between your favorite cities?

1 mile = 1.61 km (Example: From New York to Los Angeles is is 2,915 miles. 2,915 x 1.61 = 4,693 kilometers).

* * * * * * * * * * *

THE FOLLOWING ACTIVITIES, WORKSHEETS AND GAMES ARE APPROPRIATE FOR ALL GRADES IN WHICH METRICS ARE BEING INTRODUCED.

* * * * * * * * * * *

Activities to use with Worksheet I

1) Using decimeter strip, find out:

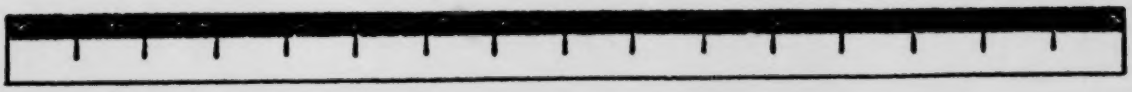
a) Is your foot longer than one decimeter?_____
b) Is your foot wider than one decimeter?_____
c) Is your hand wider than one decimeter?_____
d) Is your pencil longer than one decimeter?_____
e) Name three things longer than one decimeter._____
_____ _____
f) Name three things shorter than one decimeter._____
_____ _____

2) Find out, using decimeter strip :

a) How long is each spike on Worksheet 2? (Page 23)
b) Using real objects measure them by decimeter.

3) Make centimeter rulers like the ones on Worksheet I.

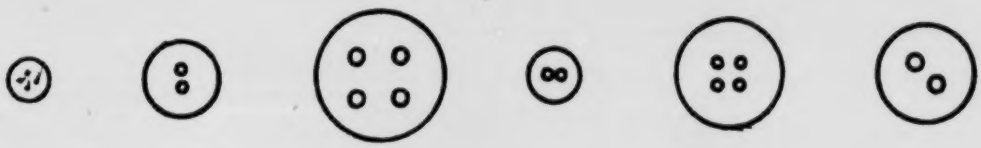
Example:



4) Cut out the centimeter strips on Worksheet I.
Each one is 1 centimeter wide.

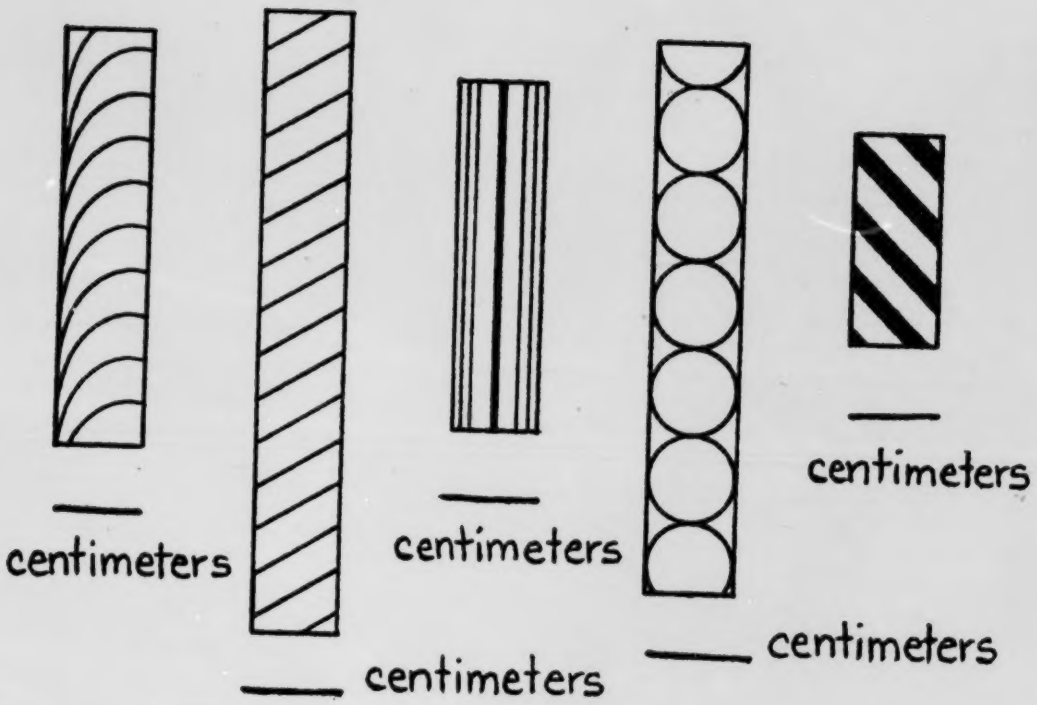
Example:

a) Make an S next to each button that is shorter than 1 centimeter across. Make an L on each that is longer than 1 centimeter across.



b) Have children sort objects longer and shorter than 1 centimeter using the strip.

5) How many centimeters long is each of these candy sticks?



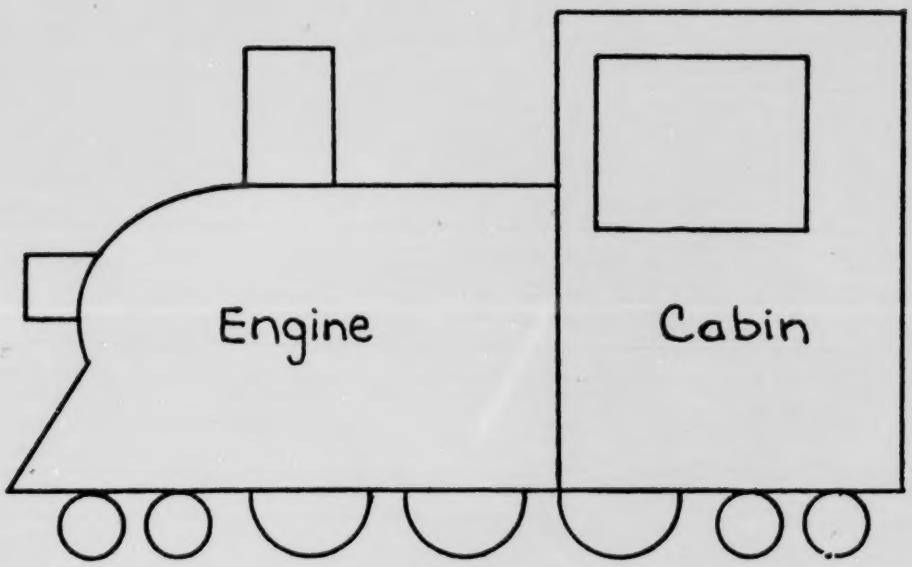
6) How long is the bottom of this engine? _____

How tall is the cab? _____ centimeters

How wide is the cab? _____ centimeters

How wide is the window?_____ centimeters

How tall is the smoke stack?_____ centimeters

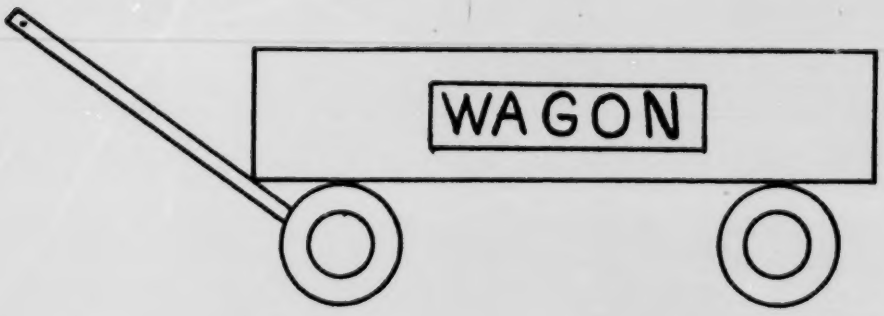


7) Measure the length of the toy wagon _____ centimeters

Measure the length of the handle _____ centimeters

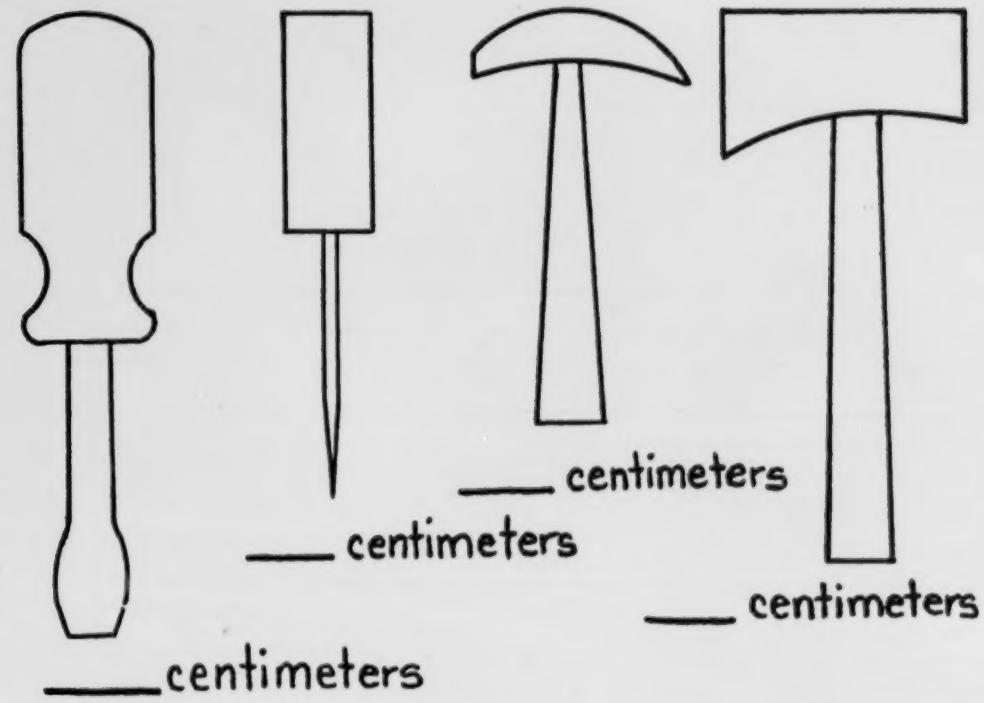
How long is the sign?_____ centimeters

How high is the sign? _____ centimeters

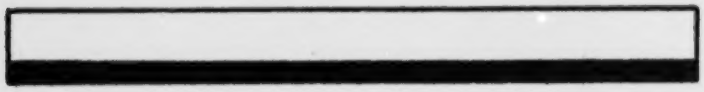


8) Measure the length of each tool picture

a) Actual tools, utensils, other objects can be measured. They should be exact centimeters in length.



9) Make a new centimeter ruler like this one. Use your centimeter ruler to mark this decimeter strip.



How many centimeters are one decimeter?

_____ centimeter = 1 decimeter.

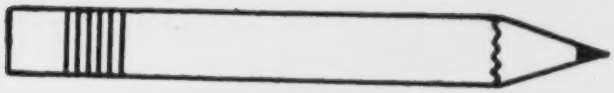
10) Students might need help with choices on this activity.

a) The pencil is longer than _____ centimeters.

b) It is shorter than _____ centimeters.

c) It is closer to _____ centimeters than to _____ centimeters.

d) To the <u>nearest</u> centimeter the pencil is _____ centimeters long.



11) Measure

a) To the nearest centimeter, find the length and width of each leaf on Worksheet 3. Record the answers. (Page 24)

b) Real leaves should be collected. Press them in plastic or wax paper. Have each student bring three (3) leaves.

12) Find and Measure six things in your classroom that are less than 10 centimeters long. (Use long, narrow objects like a pencil)

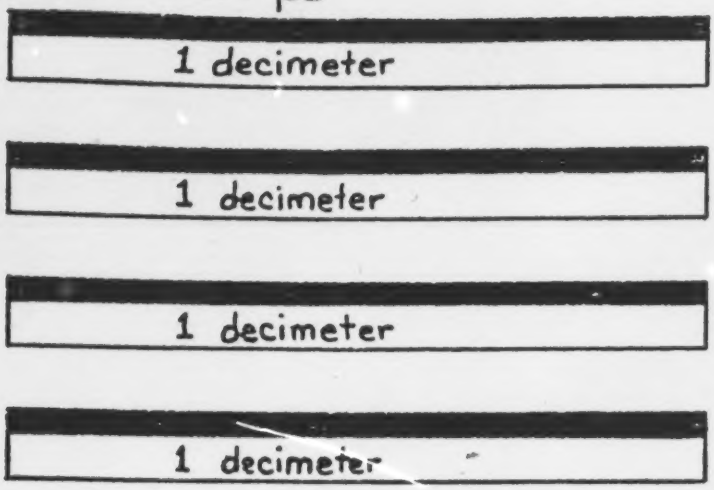
OBJECT	CENTIMETERS

13) Measure the length of the smiles of the people in your house.

Worksheet 1

REPRODUCE THIS SHEET FOR EACH STUDENT OR HAVE STUDENT TRACE A COPY

Decimeter strips

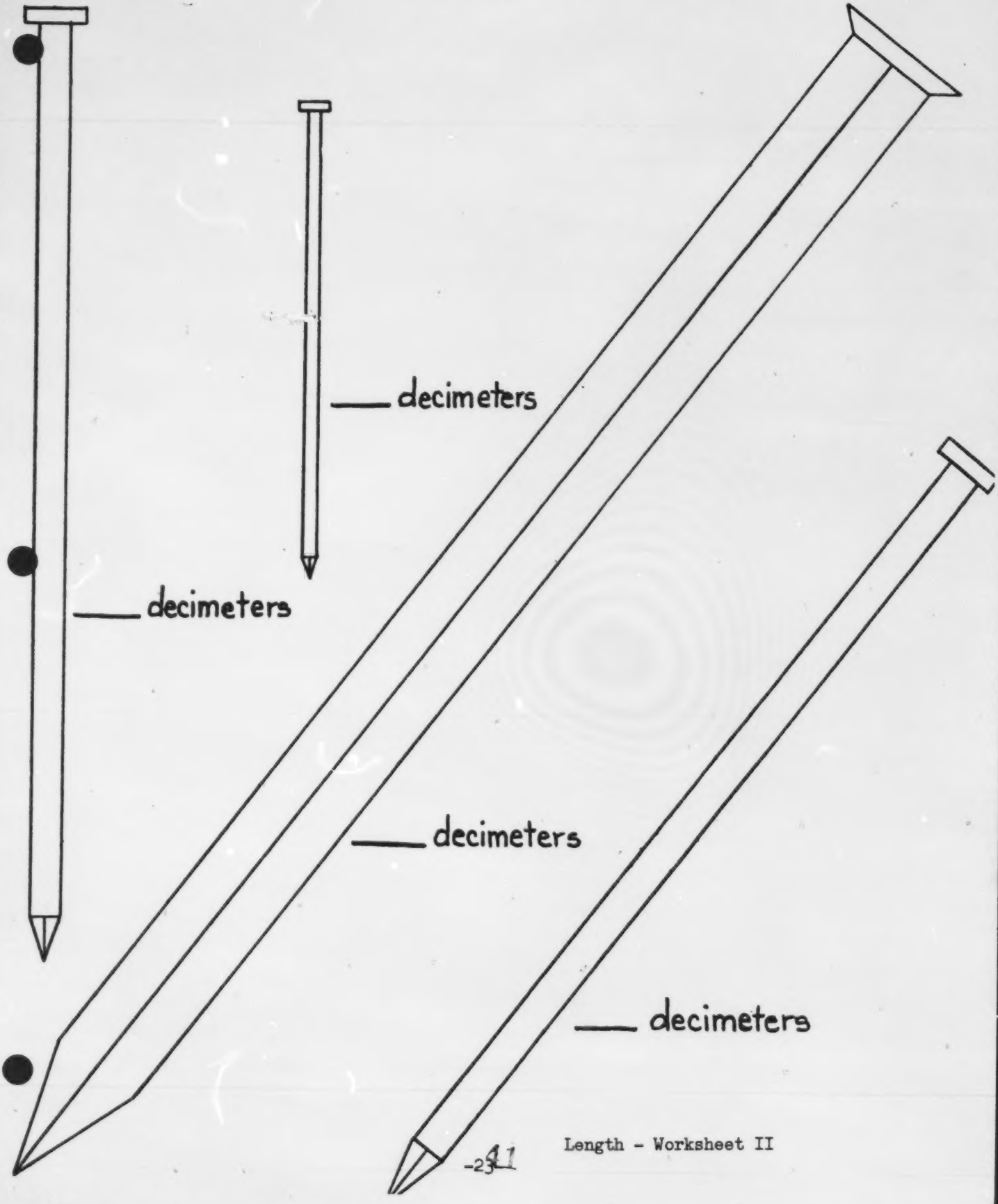


Centimeter strips

Centimeter Ruler

How long is each spike?

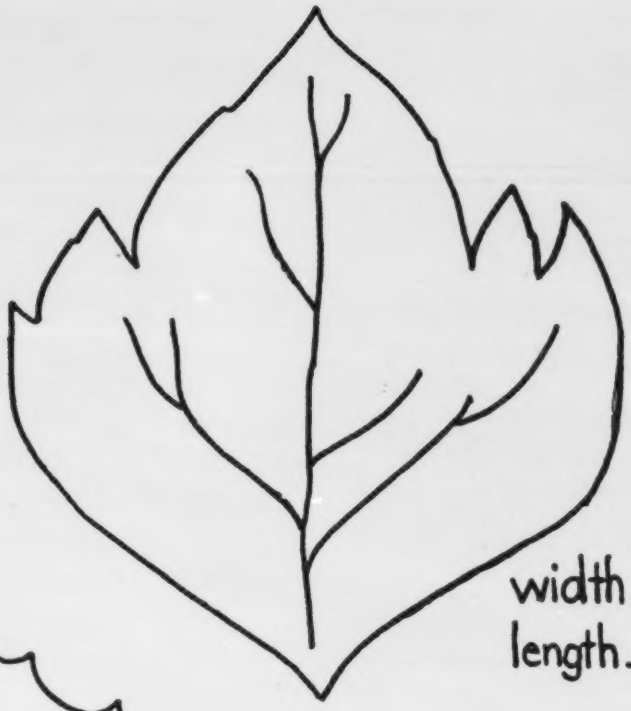
Worksheet 2



Length - Worksheet II

Worksheet 3

width ___ centimeters
length ___ centimeters



width ___ centimeters
length ___ centimeters

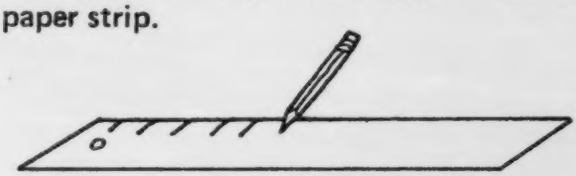
width ___ centimeters
length ___ centimeters

width ___ centimeters
length ___ centimeters

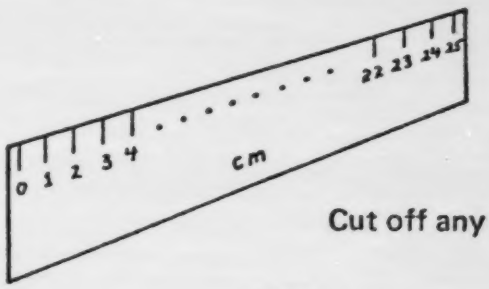
width ___ centimeters
length ___ centimeters

First, cut a strip of heavy paper.

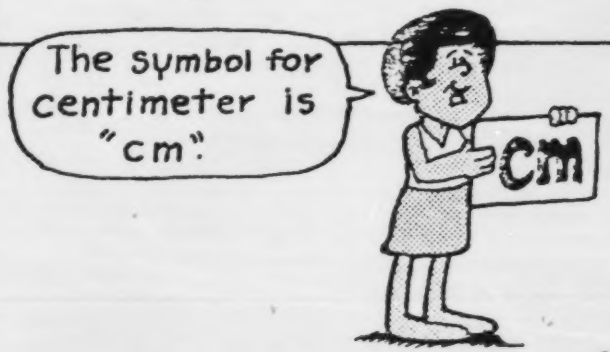
Use the ruler on the edge of this page to mark the centimeters on your paper strip.

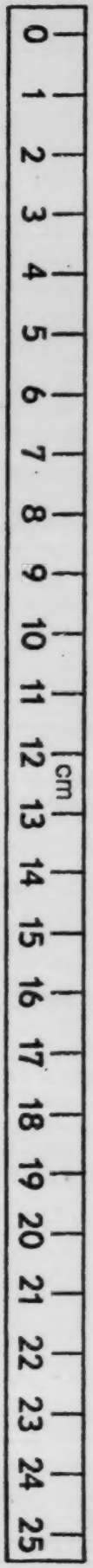


Starting at 0, number the marks from 0 to 25.



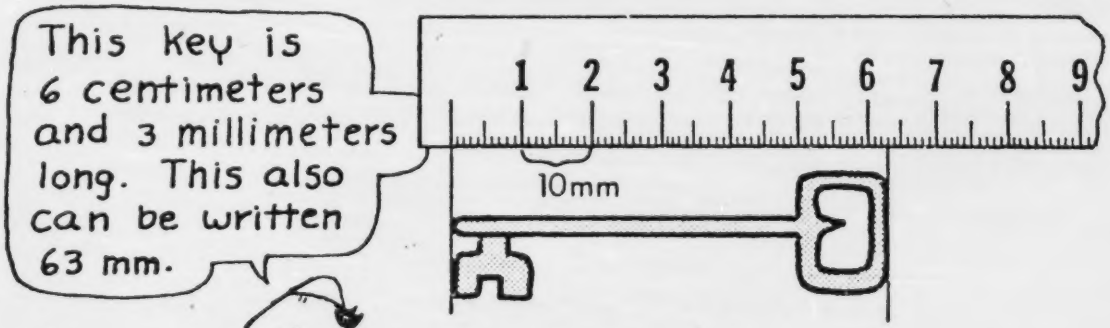
Cut off any extra paper.





Let's measure things. First guess the length in centimeters of the things in the chart. Write your guess in the space. Then find the actual measure.

WHAT TO MEASURE	GUESS MEASURE	ACTUAL MEASURE
Your pencil	cm	cm
A piece of chalk		
Your little finger		
A 12 inch ruler		
Your foot		
A comb		
A book		
Albert Ant's path		



Measure the length of

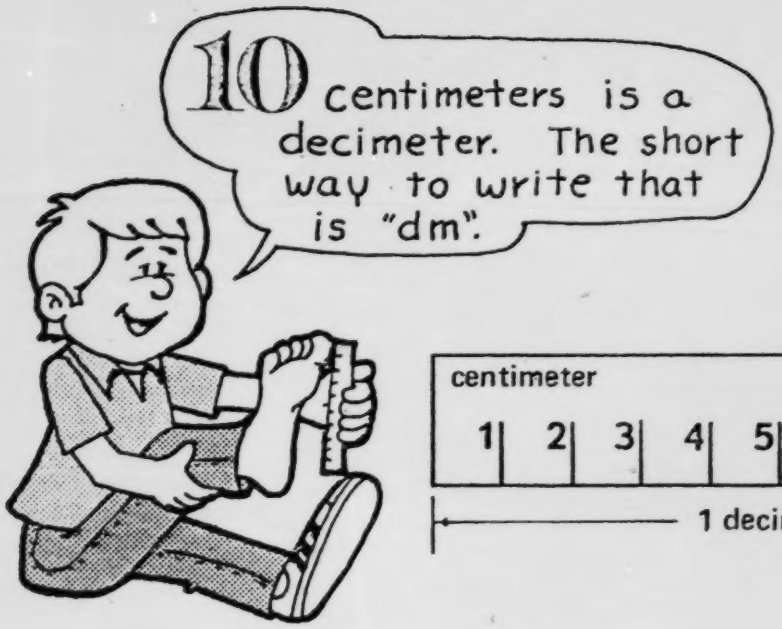
your pencil: _____ cm and _____ mm OR _____ mm

your index finger: _____ cm and _____ mm OR _____ mm

your nose: _____ cm and _____ mm OR _____ mm

_____ : _____ cm and _____ mm OR _____ mm

LENGTH IN CENTIMETERS	LENGTH IN MILLIMETERS	OBJECT ABOUT THIS LENGTH
1 cm	10 mm	
2 cm	_____ mm	
3 cm	_____ mm	
_____ cm	70 mm	
_____ cm	5 mm	
_____ cm	1 mm	
2.5 cm	25 mm	
4.7 cm	_____ mm	
_____ cm	88 mm	
_____ cm	100 mm	
_____ cm	39 mm	



Find things that are :

SHORTER THAN A DECIMETER	LONGER THAN A DECIMETER	ABOUT THE SAME LENGTH AS A DECIMETER

What does the prefix "deci" mean?

Get some string and measure somebody. Record your measurement.

HEAD _____ cm and _____ mm, or _____ mm

WRIST _____ cm and _____ mm, or _____ mm

NECK _____ cm and _____ mm, or _____ mm

ANKLE _____ cm and _____ mm, or _____ mm

WAIST _____ cm and _____ mm, or _____ mm

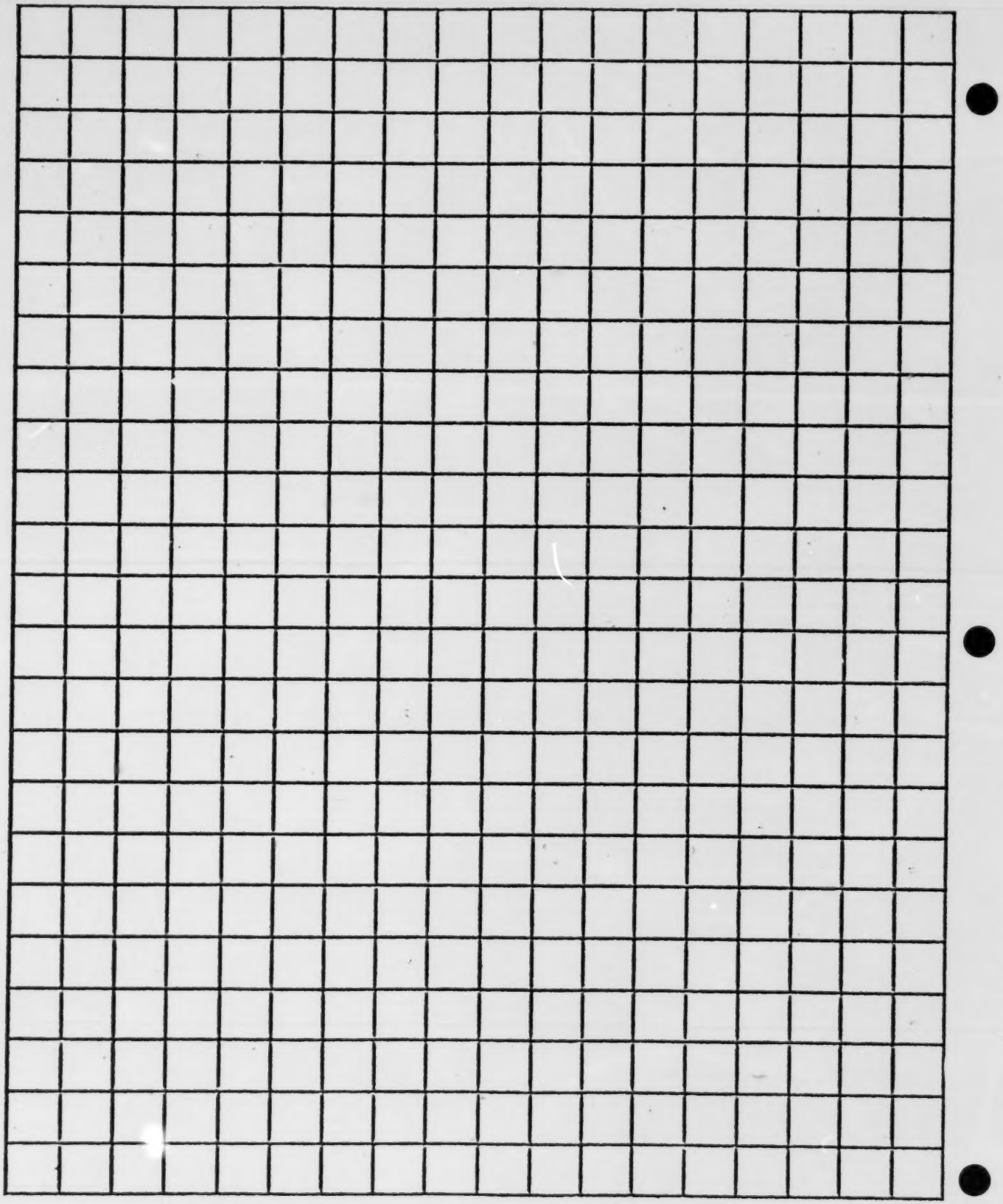
Who has the longest neck in your class?

Who has the tiniest ankle?

What is the total waist measurement of your class?

NAME	HEIGHT IN m AND cm	HEIGHT IN CENTIMETERS	HEIGHT IN METERS
Alice	1 m 9 cm	109 cm	1.09 m
Leroy	1 m 24 cm	124 cm	1,24 m

What is the average of all the heights recorded?
Who comes closest to being the average height?



1 centimeter (cm) grid to be reproduced for class use in measurement activities.

VOLUME

Metric Measures for Volume

1000 milliliter (mℓ)	equals	1 liter (ℓ)
1000 cubic centimeters (cm^3)	equals	1 liter (ℓ)
1000 cm^3	equals	1 cubic decimeter (dm^3)
1000 (ℓ)	equals	1 cubic meter (m^3)
1000 dm^3	equals	1 cubic meter (m^3)

Guides for Volume Measures

The weight of 1 cubic centimeter of water is called a gram.

The weight of 1,000 cubic centimeters (cm^3) of water is called a liter (ℓ).

1/1000 of a liter (ℓ) is called a milliliter (mℓ) (a liter is slightly larger than a quart).

small concentrated juice can	equals	200 milliliter (full)
standard soup can	equals	315 milliliter (to rim)
coffee can (diameter 10 cm, height 14 cm)	equals	1,000 mℓ or 1 liter (to rim)
quart bottle	equals	940 milliliters (mℓ)
pint bottle	equals	470 milliliters (mℓ)
cup	equals	235 milliliters (mℓ)

VOLUME
EARLY CHILDHOOD

I. Goal: To teach capacity through conservation of quantity and non standard units of measure

To introduce metric concepts and terms

II. Activities to Achieve Goal

1. The purpose of this activity is to familiarize children with the concept of conservation of quantity. Have available containers of varying sizes. For solid volume measures use tissue boxes, containers, cups, etc. For liquid measures use juice containers, milk containers, bottles, etc. Use clear containers if possible.

   Example of how to proceed on using liquid measures:

   a) Instruct child to fill one box or container with water... have him/her fill another sized container or box with exactly the same amount of water. Which contains more?

   b) Have child transfer contents to another size container Which was more full? ... less full?

   Until the child is able to conserve quantity through this game, he is not ready to proceed to other activities.

2. Children should be permitted to explore the capacity of various containers and the relationships between the varying sized containers.

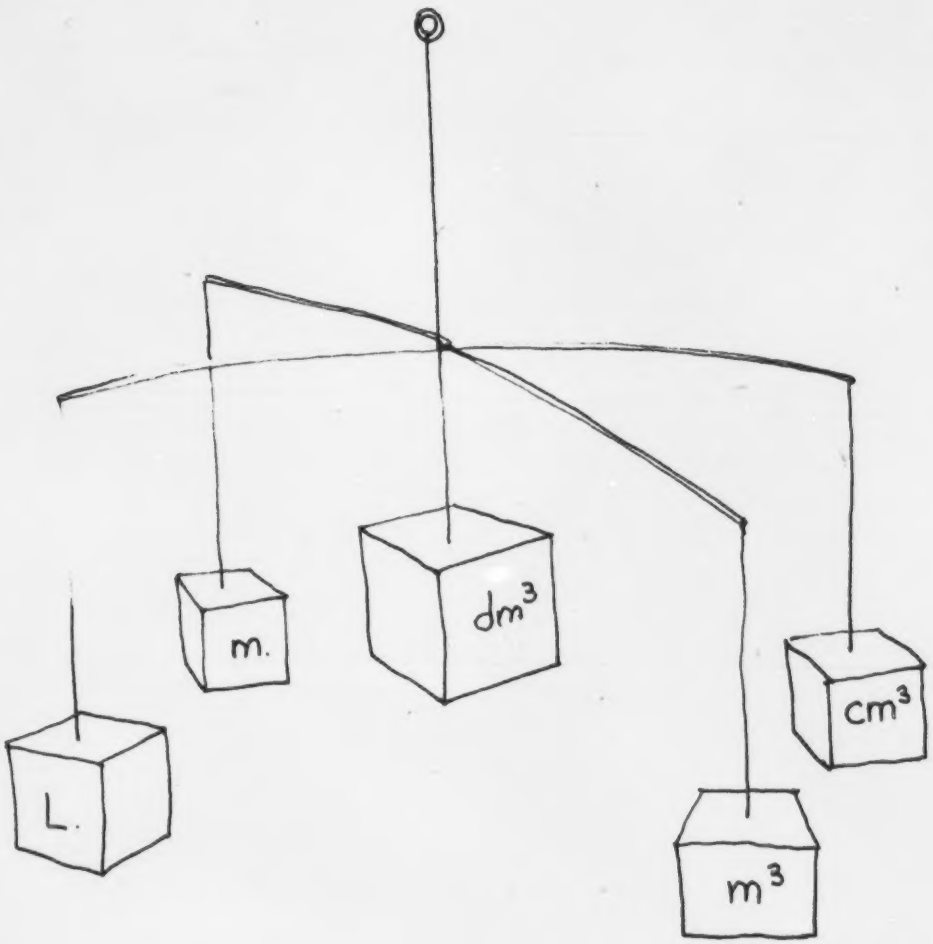
   To familiarize children with metric units, have all containers clearly labelled (liter, cubic, centimeter, etc.)

3. Make a Volume Mobile in order to display the sizes of various volumes. Have available various containers such as paper cups, milk cartons, boxes, etc.

   a) Using the various sizes of volume measures, have children make a mobile. What sizes can we put on it? Children should measure and label all materials to be used.

3. (continued)

b) On the mobile, hang cups with volume measured in metric values, small boxes and cubes made to equal 1 cm^3, 1 liter (ℓ) etc.



UPPER GRADES

I. Goal: To introduce more difficult metric concepts (cubic decimeter, dm^3)

To introduce and reinforce the fact that all the common measurements are related to the meter.

To teach how to compute volume (length x width x height = volume)

II. Activities to Achieve Goals:

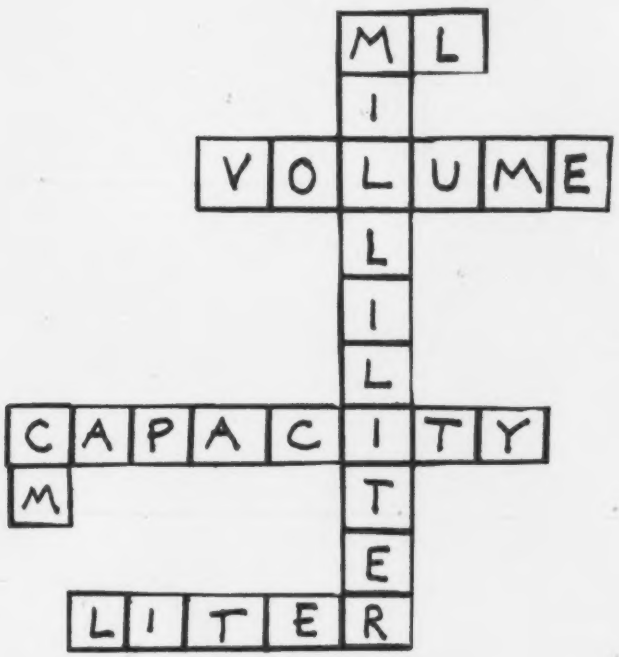
1. Use this crossword puzzle to review terms relating to volume measure. Reproduce this puzzle or have children create their own.

ACROSS

1. abbreviation for milliliter
2. amount of liquids in a container
3. the maximum amount of liquid a container can hold
4. the amount of volume in a cubic deciliter

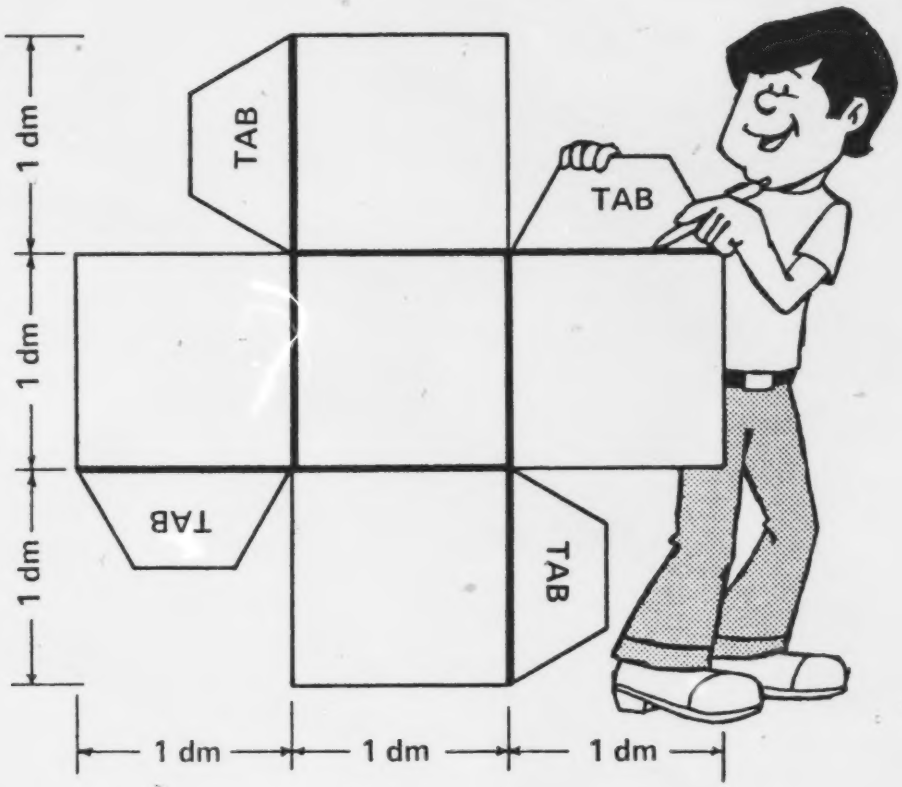
DOWN

1. 1/1000 of a liter
2. abbreviation for cubic centimeter



2. How does one measure volume? A white cuisenaire rod is one cubic centimeter (1 cm^3). Take any size box and fill it with white cuisenaire rods. How many rods fill the box? What does this tell you about the volume of the box? Repeat this procedure with different size containers.

3. Here is another way to reinforce the concept of volume. For a cubic centimeter (cm^3), use a white cuisenaire rod. To make a cubic decimeter (dm^3), have the children make their own following this diagram.



a) How many cubic centimeters (cm^3) will fit inside the one cubic decimeter?

b) How many centimeters is each edge of the cubic decimeter (dm^3) cube?

c) How many millimeters is each edge of cubic centimeter (cm^3) cube?

d) How does this help you to find the number of cubic millimeters (mm^3) and cubic centimeters (cm^3) in one cubic decimeter (dm^3)?

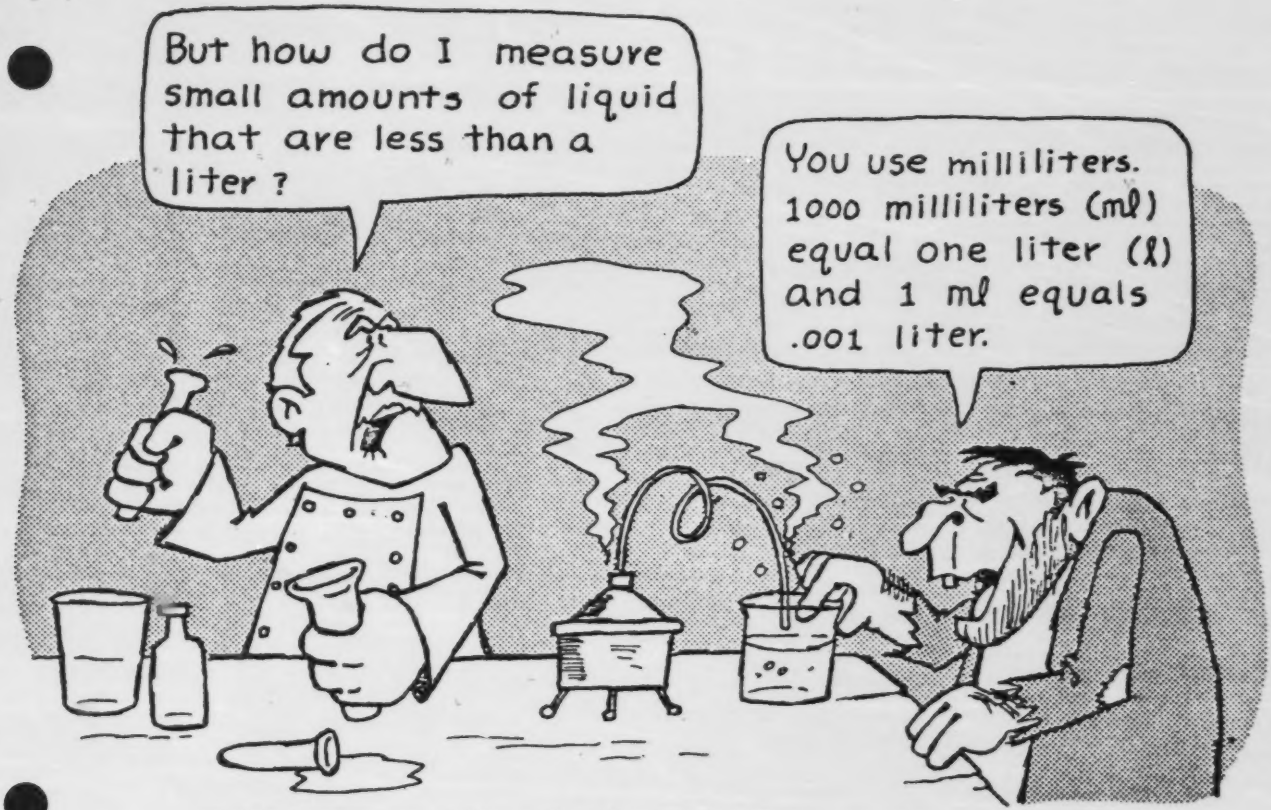
4. Complete the following table:

10 millimeters (mm) = 1 centimeter (cm)	
100 sq. mm (mm^2) = 1 sq. cm (cm^2)	
1) _____	cubic mm(mm^3) = 1 cubic cm (cm^3)
2) _____	centimeters (cm) - 1 dm
3) _____	cm^2 = 1 dm^2
4) _____	cm^3 = 1 dm^3
5) _____	mm^3 = 1 dm^3

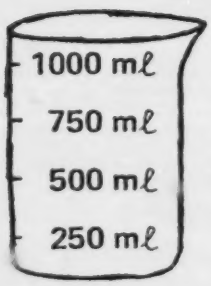
5. Complete the following table:

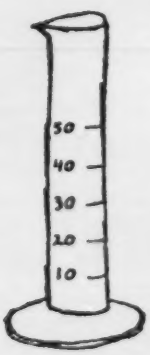
1) _____	mm^3 = 1 cm^3
2) _____	cm^3 = 1 dm^3
3) _____	dm^3 = 1 m^3
4) _____	m^3 = 1 km^3
5) _____	dkm^3 = 1 km^3

6. The following activity sheets will reinforce volume concepts.


But how do I measure small amounts of liquid that are less than a liter ?
You use milliliters. 1000 milliliters (mℓ) equal one liter (ℓ) and 1 mℓ equals .001 liter.

Collect some containers that have milliliter measures.





METRIC MUD

125 mℓ *cold* water

250 mℓ corn starch

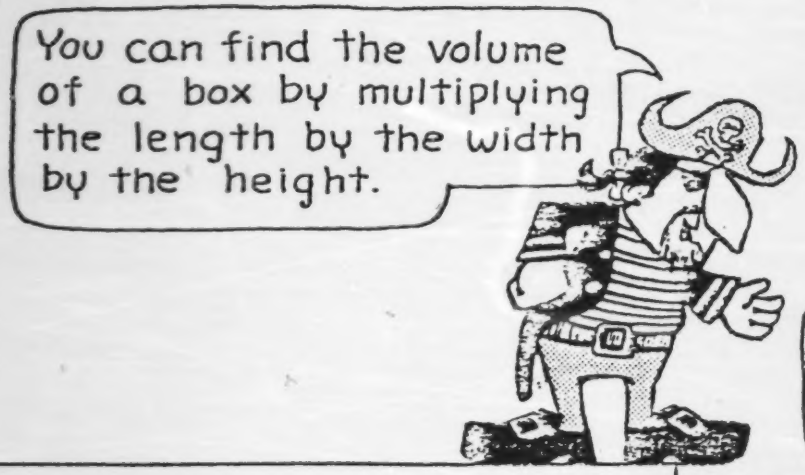
Mix water and corn starch in a bowl.

Stir the mixture fast. What happened? Write a description.

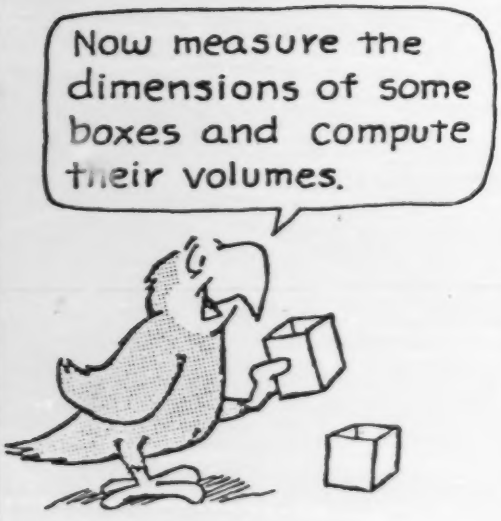
Hit the surface hard with your hand.

Slowly push your finger into the mixture. Did you touch the bottom both times?

Pull out your finger fast. Write a description of how it felt.



LENGTH	x	WIDTH	x	HEIGHT	=	VOLUME
1 cm	x	1 cm	x	1 cm	=	1 cm^3
2 cm	x	3 cm	x	1 cm	=	____ cm^3
5 cm	x	4 cm	x	2 cm	=	____ cm^3
2 cm	x	2 cm	x	3 cm	=	____ cm^3
7 cm	x	5 cm	x	2 cm	=	____ cm^3
____ cm	x	____ cm	x	____ cm	=	____ cm^3



OBJECT	LENGTH	x	WIDTH	x	HEIGHT	=	VOLUME
match box	_____	x	_____	x	_____	=	_____
staple gun	_____	x	_____	x	_____	=	_____
soap box	_____	x	_____	x	_____	=	_____
chalk box	_____	x	_____	x	_____	=	_____
	_____		_____	x	_____	=	_____

TEMPERATURE

The Metric Temperature is based on 100 steps. In 1742 Anders Celsius, a Swedish scientist, devised this scaling - called the centigrade (centi = hundred in Latin, gradus = degree in Latin). In this scale the freezing point for water = 0°c and the boiling point 100°c. There are 100 divisions between freezing and boiling. (Fahrenheit thermometers have 180°) Minus readings on the Celsius' scale meant below the freezing point of water.

Measures for Temperature - Celsius
(c - Celsius or Centigrade)

0° c = Freezing point

22° c = Average room temperature

37° c - Normal body temperature

100° c = Boiling point

Guides for Temperature

The coldest spot in your freezer is about minus thirty degrees Celsius (C).

The average temperature in the freezer is around minus twenty degrees C.

Water freezes at 0 degrees and boils at 100 degrees C.

A slow oven is 130 degrees C.

A moderate oven is 180 degrees C.

You do deep-fat frying at 190-200 degrees C.

A hot oven will be 240-260 degrees C.

You broil at 285-290 degrees C.

Metric Measurement Temperature - Early Childhood

I. Goal: To supply concrete experiences to teach children to think in terms of centigrade temperatures.

II. Activities to achieve goals

1) You must have a centigrade thermometer. Using a centigrade thermometer, graph the temperature for the week.

2) Match pictures of activities to estimated temperature. (Worksheet A)

3) Measure the temperature of different liquids familiar to the children such as ice, coke, milk, juice, soup, coffee, boiling water. Make a chart - Record from the coldest to the hottest.

4) Measure temperature in different areas of the school. 1st floor, classroom, by window, in basement, on the roof. Record and graph the results.

5) Measure child's temperature - Graph Results.

a) Compare children's temperature
b) Take child's temperature at different times of the day.

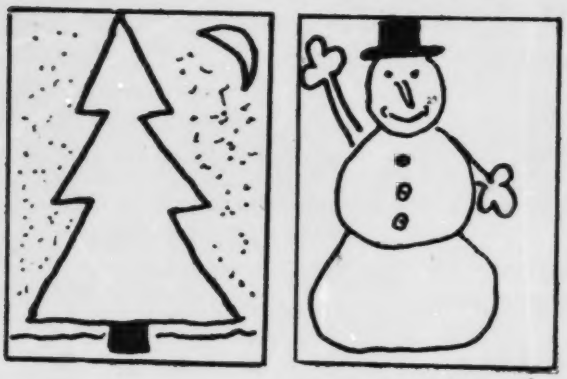
6) Have children cut out pictures from magazines of :

a) Activities - i.e., football, baseball, tennis.
b) Types of food - boiling water, ice cream, ice, franfurters.
c) Places - North pole, desert

Make estimate of temperatures to pictures.

7) Develop card games. Make series of cards on stiff cardboard using different pictures.

a) Match pictures of same temperature
Have an odd card (i.e: Old Maid)



b) Match picture card to a temperature scale card.

Upper Elementary Grades

I. Goals: To have children understand the Centigrade scale

To have children be able to estimate Celsius scale temperature

To have children compute and understand the following conversion:

$F = \frac{9}{5} c + 32$

C - F - 32 then $\frac{5}{9}$

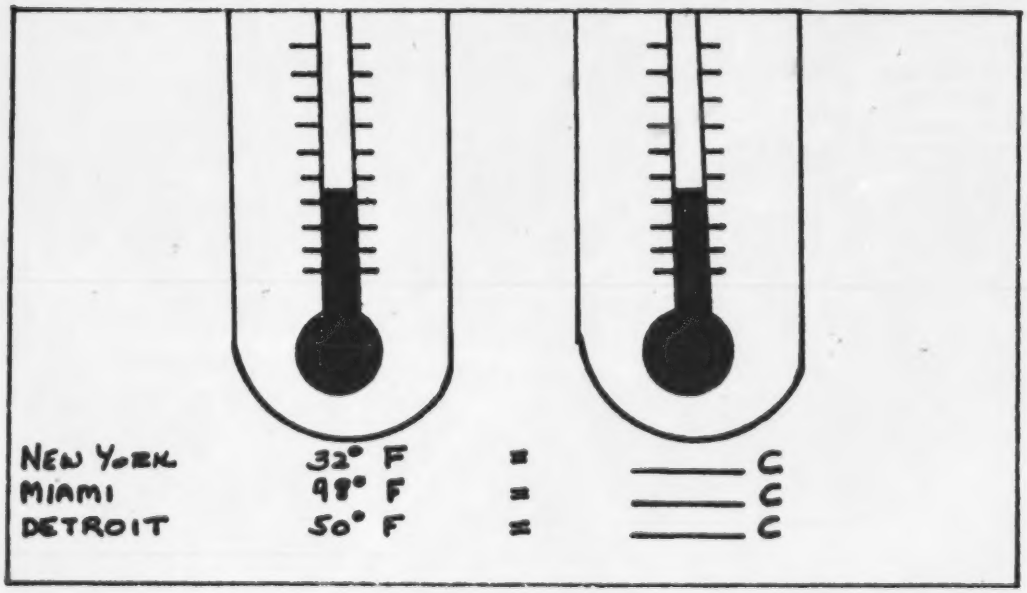
II. Activities to achieve goal

1) Graph temperatures at different hours of a day.

2) Cut out temperatures from weather report listing American Cities, World Cities. List cities and on a Celsius scale record them from coldest to hottest - Graph them.

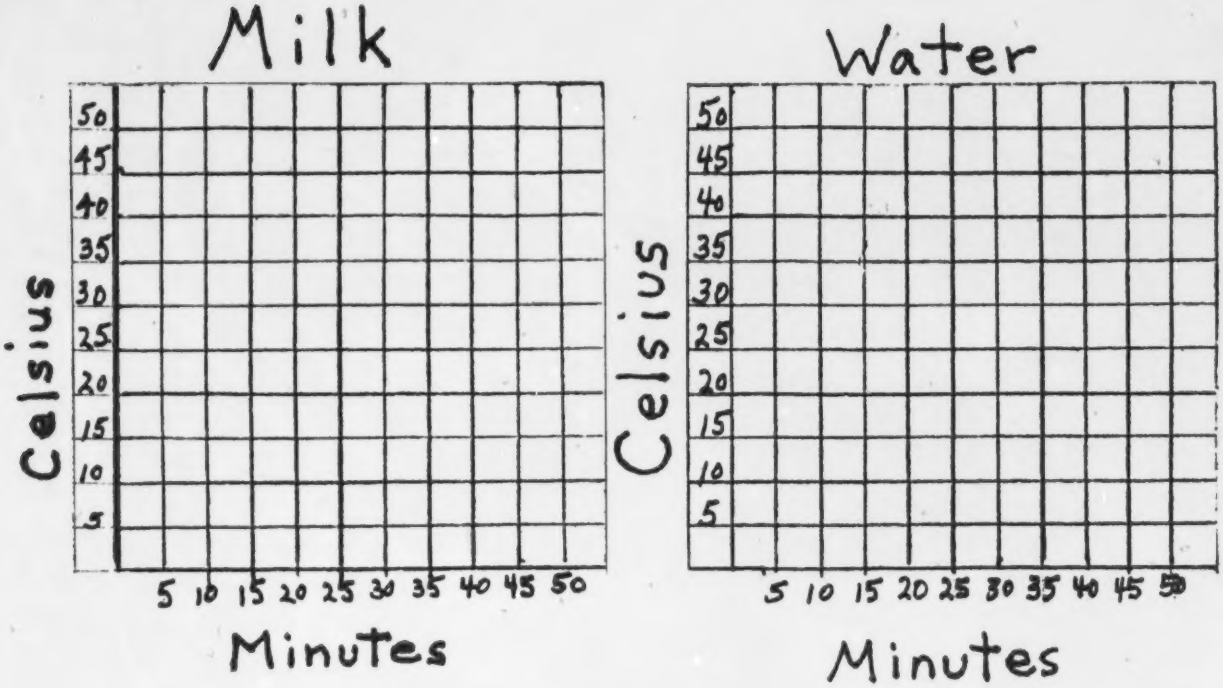
3) Record temperatures at same hour for 5 days in a row - Graph results.

4) Go back to Temperature, p. 1 - Guides. Have children make a chart comparing these temperatures.



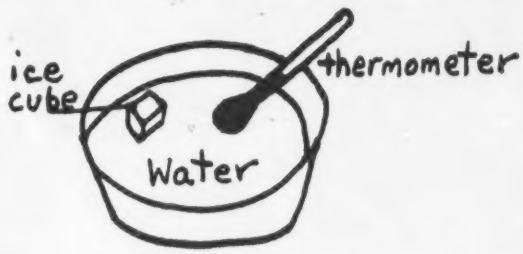
5) How quickly does water cool?

Boil water. Measure temperature of water at 5 minute intervals. Record results and graph. Compare with another liquid, i.e.: milk. Is there a difference? Why?

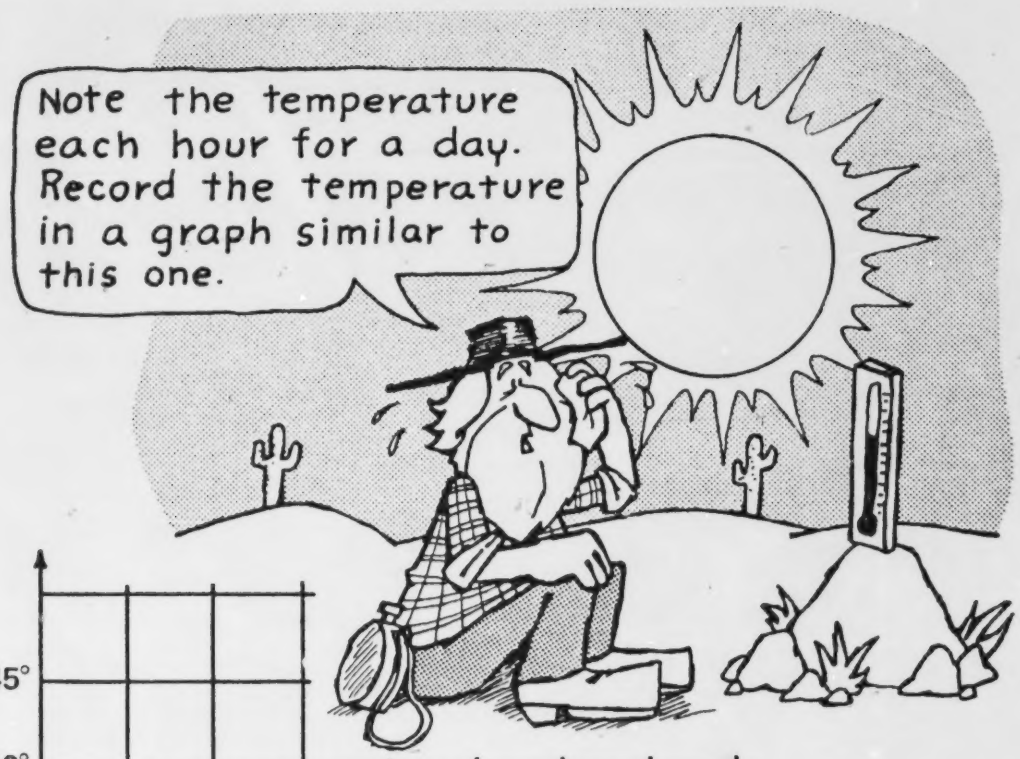


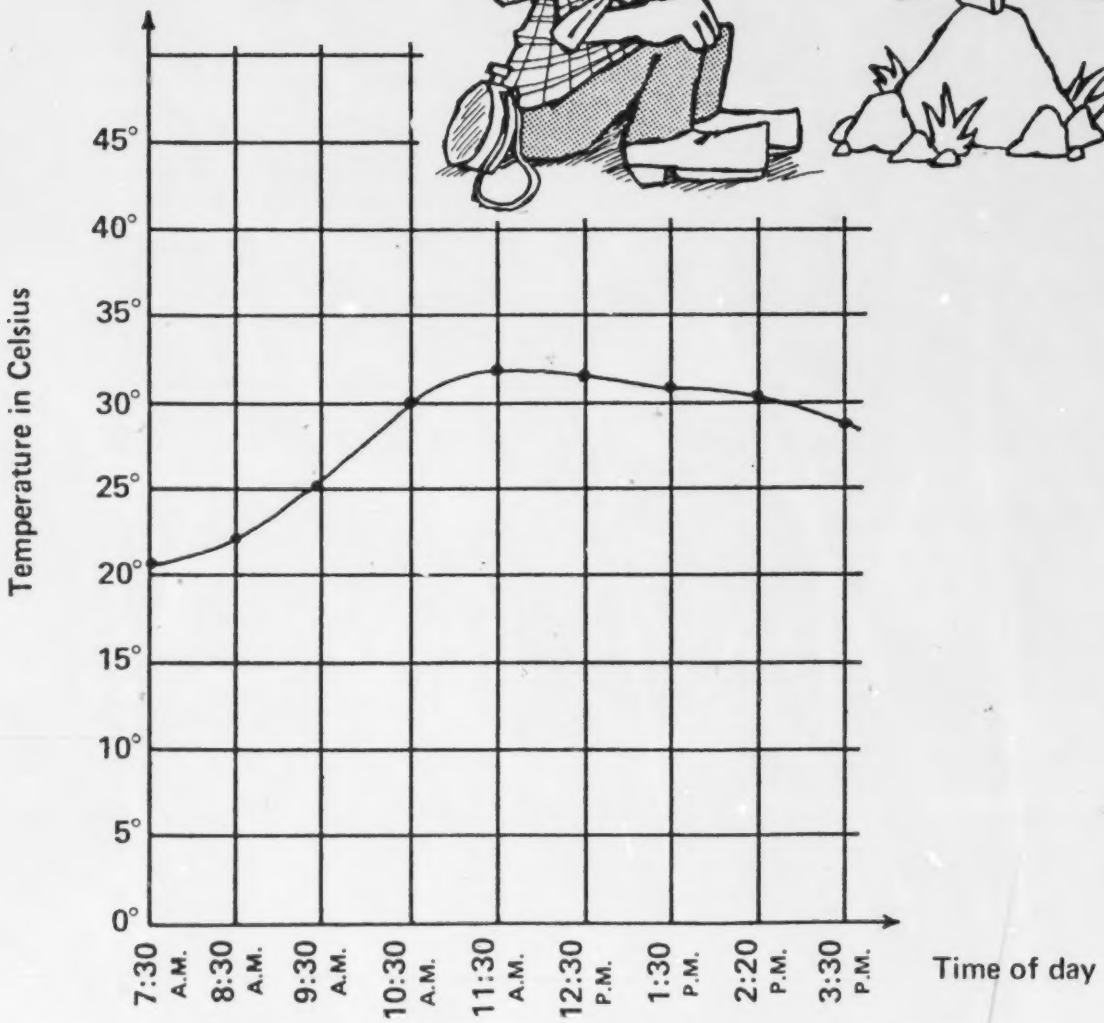
6) What is temperature of the water in which a piece of ice is floating?

Measure at 5 minute intervals. Record results and graph. Compare with another liquid, i.e.: milk.



7) Variations on above. Measure the temperature of water from room temperature to ice. Compare various liquids.





When was the hottest hour of the day? When did the temperatures rise the fastest?

WHAT KIND OF DAY IS IT?

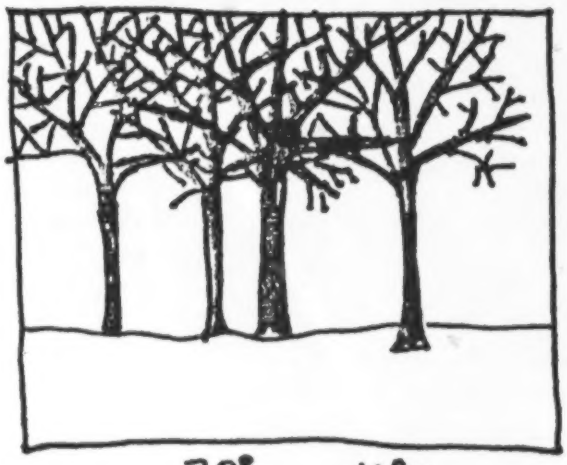
Is the temperature
hot or cold?

Circle the best temperature.

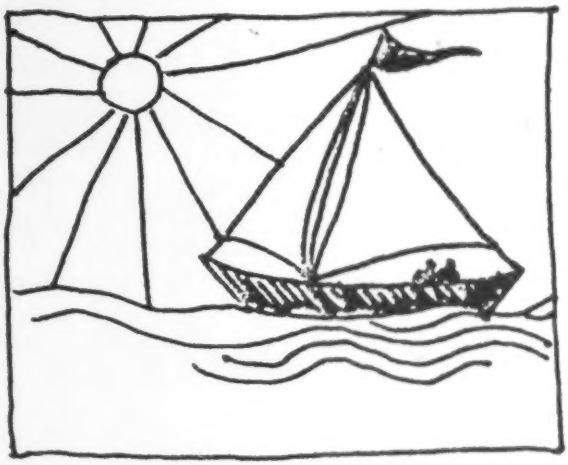
5°c 25°c

5°c 32°c

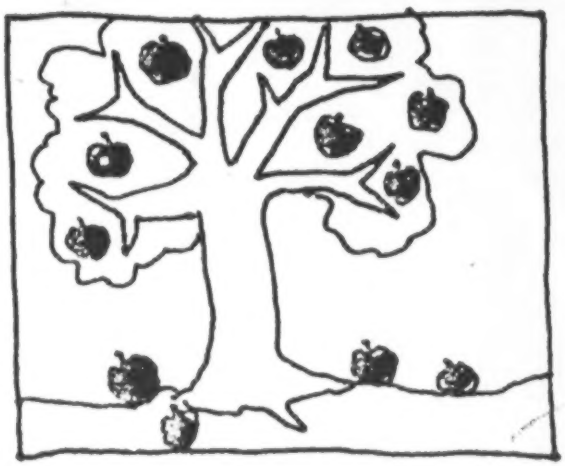
0°c 30°c



38°c 10°c



30°c 50°c

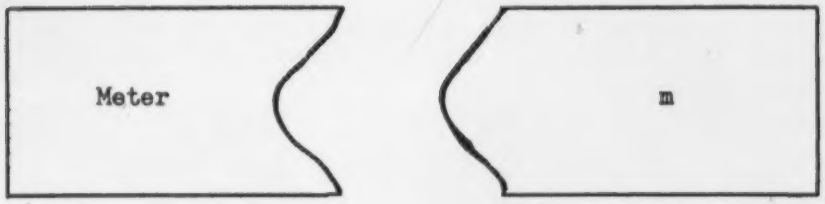


15°c 80°c

METRIC GAMES

(To reinforce symbols)

METRIC SCRAMBLE



Materials

Set of cards as shown above, labelled and with interlocking pieces.

Procedure

1) All cards with interlocking pieces are placed face up in front of the child.
2) Child seeks a card bearing metric measure name and then locates the interlocking piece which bears corresponding metric measure symbol.
3) Once selection is made, the interlocking pieces are placed adjacent to one another.
4) If the pieces "lock", the child then seeks another card bearing metric measure name, and follows the same procedure.

Variations

Reverse selection order; begin with metric symbol
Make this a group activity
Color code lettering to aid children with reading difficulty

METRIC BINGO

dg	dam	cm	hm	dag
hm	dm	FREE	km	mm
ℓ	g	kg	hg	cm

Materials

Bingo-like cards with metric symbols in squares
Buttons or chips for markers
Answer cards with symbols and corresponding words

Directions

Caller begins by calling out one unit by name. Students cover corresponding symbol(s) on their card. Play continues until a child has covered a row of 5 spaces and calls out, "METRIC". Winner reads symbols to caller who checks against units called. Winner may then become caller.

Variations

Calling may be in the form of a quiz. Caller may say, "1,000 meters is a _____?" Students would then cover "km"
Lotto: Place metric word cards face down. Child turns over a card and places it on appropriate symbol. One child can play this way.

METRIC CONCENTRATION

Materials

28 cards; 14 with metric measures; 14 with metric symbols

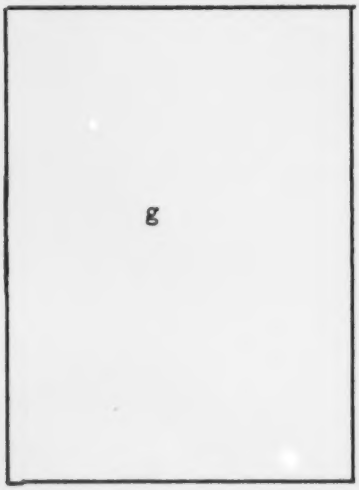
Procedure

1) Place all 28 cards face down

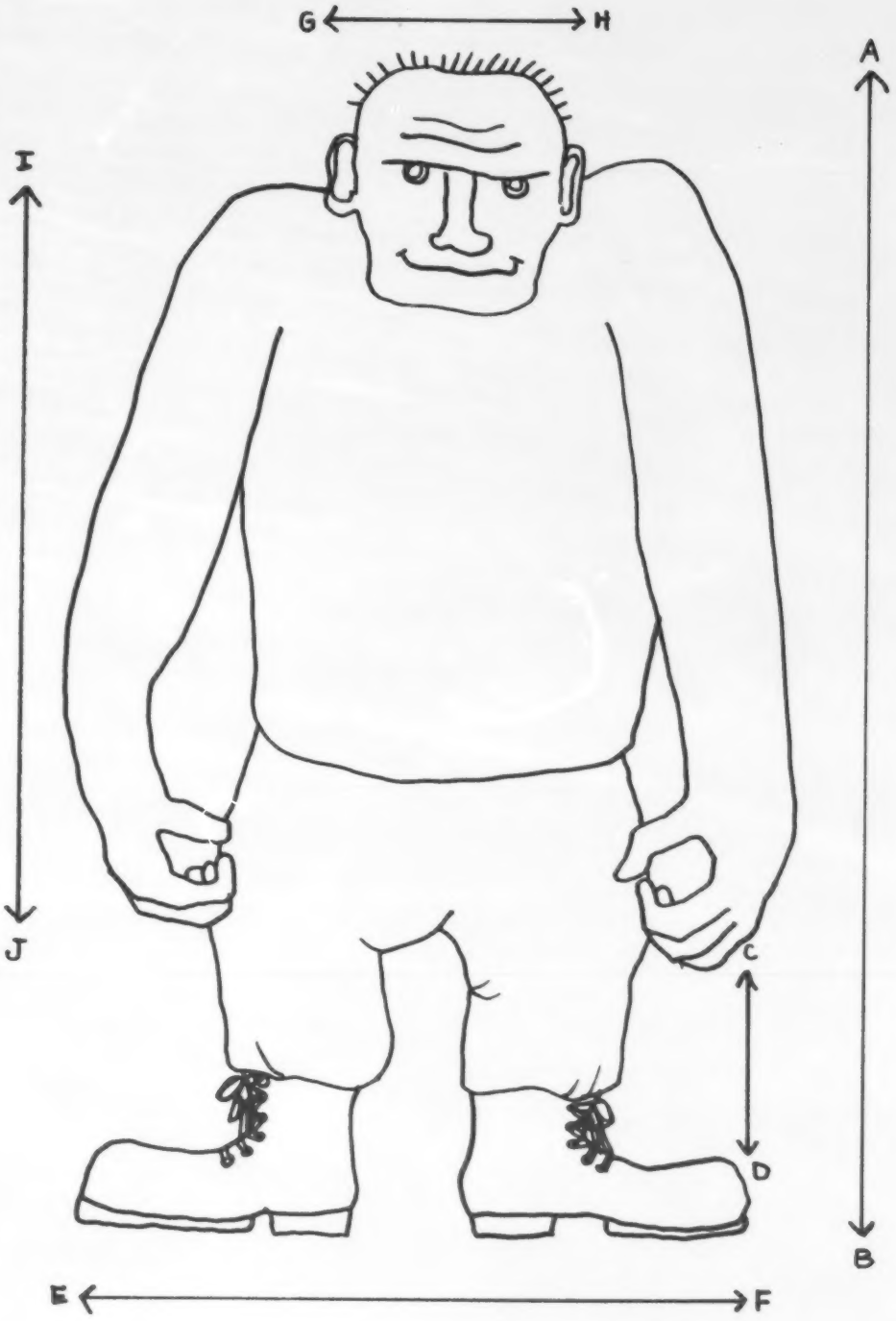
2) First player draws two cards. If the two cards match (metric measure and symbol), the cards are placed face up in front of him. If the cards do not match, he repositions them face down as they were originally.

3) The next player follows the same procedure.

4) Play continues until all cards are won. The player with the most matched pairs is the winner.



METRIC MONSTER

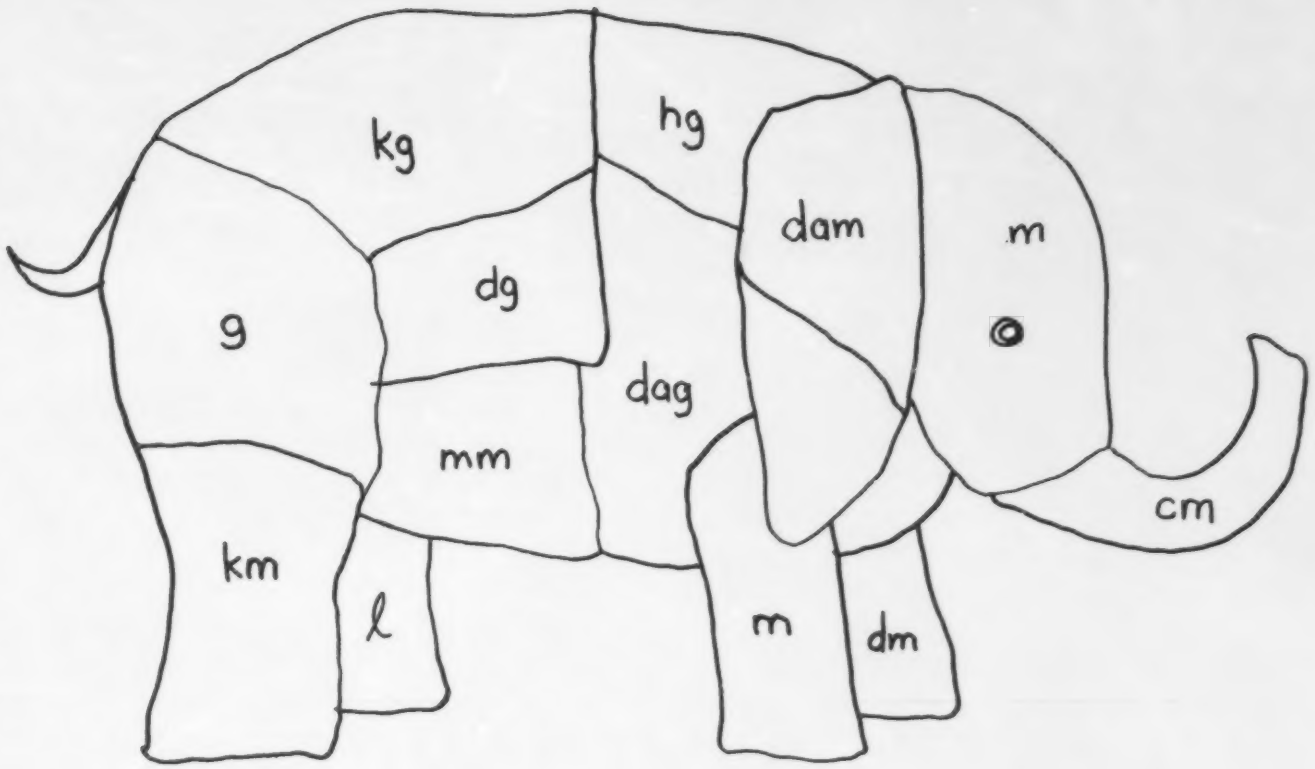


Metric Monster

Trace a picture from a coloring book. Draw lines between different parts of the picture (connecting feet, arms, ears for example). Then ask students to measure the connecting lines in centimeters and millimeters. Bring in five or six metric questions per drawing.

A to B	equals	_____ cm or _____ mm
C to D	equals	_____ cm or _____ mm
E to F	equals	_____ cm or _____ mm
G to H	equals	_____ cm or _____ mm
I to J	equals	_____ cm or _____ mm

MATCH ME METRIC



Match Me Metric

Materials

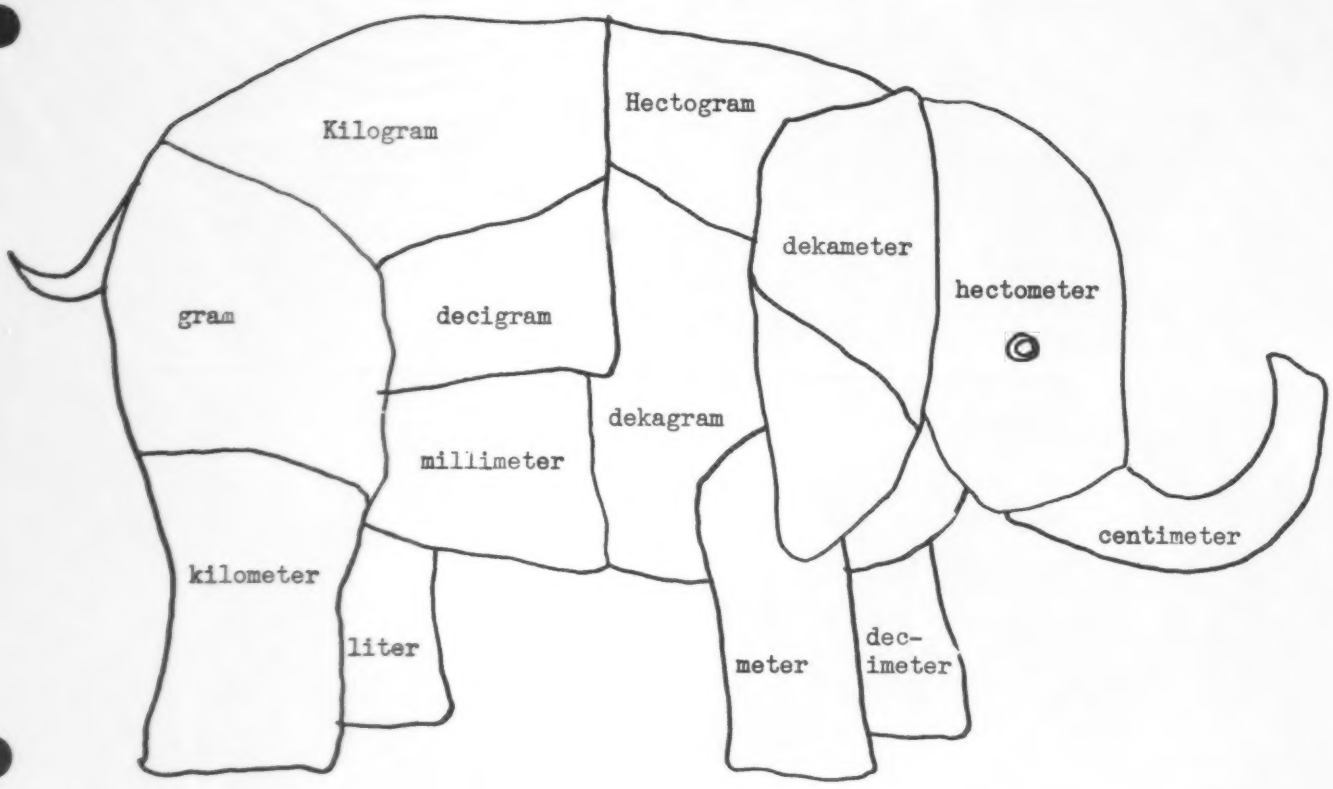
Gameboard with outline shape

Divide shape into regions with a metric symbol (abbreviation) in each

Puzzle pieces with corresponding shape and metric measure name

Instructions

Child takes puzzle piece and locates region on shape that matches name and symbol.



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